SCIENTIFIC AGRICULTURE

Vol. XI. NOVEMBER, 1930 No. 3

SOME BASIC FACTORS INVOLVED IN THE PRODUCTION OF BETTER GRADES OF APPLES*

J. H. Gourley †
Ohio Agricultural Experiment Station, Wooster, Ohio, U.S.A.

The public has come to expect uniformity in practically all of the commodities it buys. This is true in natural as well as manufactured products. As a result business has standardized nearly everything and attempts to group products into grades. The purchaser then knows, or should know, what the contents of any given package or container will be. Such a situation stimulates confidence and tends to eliminate dissatisfaction.

But it is difficult to produce at will a crop like apples that can be graded according to prearranged standards because of the many variable natural factors involved. This results in disagreements with the middleman and disappointments with the consumer. As horticulturists, it is our problem to analyze the basic factors involved and learn if we can how to control them to our advantage.

Each large region is likely to vary somewhat in the requirements set up for its different grades. The market catered to will largely determine what these requirements shall be. At least three factors are bound to be involved in every consideration of grades: namely, size, color, and finish of the fruit, the latter to include freedom from blemishes. Soundness of the fruit is of course to be assumed. It will be these three that will receive our attention in this paper. Two other factors should also be recognized, however, as basic even to those mentioned above. These are the personal element in production and the variety itself. A district cannot accomplish much without an enlightened and coöperative group of growers, for the grower is the real unit. He should be familiar with the grades and methods of grading and should be constantly urged to improve the quality of his products. It is too late to influence the quality after the fruit is delivered to the packing-house. Likewise, the variety must still be considered the corner-stone of our fruit industry for we cannot rise any higher in the production of size, color or quality of the product than the genetic possibilities bound up in it.

Size of Fruit

Packages usually are marked with the number or size of apples they contain. Grading machines are built to sort the fruit into sizes, and color and blemishes must be detected by eye. True, size does not determine the grade since either a small or a large apple may be "fancy," and grading laws do not specify the size required for any given grade, yet it is bound to enter into any consideration of this subject. Usually the fruit averages too small rather than too large so that the orchard operations that will eliminate the

*Open lecture presented at the tenth annual convention of the C.S.T.A. at Wolfville, N.S., June 24, 1930.
†Chief, Department of Horticulture.

small and poorly developed fruit and increase the percentage of larger fruit are usually to be employed. Gaston (*3*) of Michigan cites one grower in that state who had 94.4 per cent of his Baldwin apples go into the B grade because of poor size, another one 63.0 per cent for the same reason. He states that in 1924 more than one-half, and in 1925 nearly one-third of the B-grade apples in the packing houses under observation, were placed in that grade because of lack of size. Baldwin, Wagener, Jonathan, Canada Red and Grimes Golden are the varieties listed in Michigan as most likely to be below A grade because of poor size. An analysis of the problem in other Eastern states would doubtless show much the same situation with most of these varieties. The remedy for this situation will vary depending upon the cause but three practices have a bearing, aside from selecting varieties that average large under most conditions. These are thinning, pruning and soil treatment.

Thinning of the fruit is by all odds the most important method of securing fruit of commercial size. Much data have been secured to show the direct effect on the size of fruit the year in which the thinning is done. It is needless to cite these data in this paper but we may say that some renewal of this work at the Ohio Station has again shown its value. In Ohio the growers generally are thinning apples and peaches more than at any time in the past. The practice is bound to increase in an effort to solve this problem of fruit grades.

It is something of a moot question as to whether pruning will increase the size of fruit. Evidence can be presented upon both sides of this question. The writer, while familiar with the contrary evidence, favors annual light pruning of trees, partly for the beneficial effect that frequently results on the quality of fruit produced. The experienced fruit grower is familiar with the fact that young trees are likely to produce larger fruit than old ones. Hence any practice that tends to keep trees "young", tends to maintain higher yield. Pruning has a rejuvenating effect and in our Ohio experience usually results in a beneficial effect upon size. With such a variety as Rome Beauty which is largely grown in my state it is essential to follow a definite system of pruning to eliminate small size and poor color.

It cannot be argued that the application of fertilizers and the use of good cultural methods will, of themselves, increase size of fruit. Frequently the opposite is true because fertilizers may result in an increased set of fruit. However, a vigorous condition of the tree favors normal development in size provided the tree is thinned to the proper distance.

Color of Fruit

In most fruit sections a high development of red color is the limiting factor in the production of the better grades. Likewise it is the most difficult of all factors to improve. Until recently little definite work has been done on this problem as it relates to orchard fruits, yet its economic importance is very great.

What is Color?

The question may properly be asked, What is color? Of what does it consist? Under what conditions does it develop? Color is, of course, familiar

to us in nature. Green is most common, although other colors in flowers, fruits and leaves are likewise familiar. These colors are due to small colored bodies within the cells known as plastids, and the plastid pigments are responsible for the orange, yellow and green colors. Such colors as blue, purple, violet, magenta and nearly all the reds are due to soluble anthocyanin pigments. Still other colors such as scarlet, orange-red, browns and black are often produced by the presence of both plastid and anthocyanin pigments together in the tissues. Yellow color is frequently due to carotin and xanthophyll, both constituents of the chlorophyll of green leaves. (4).

The anthocyanin pigments arise from a product known as chromogen, which in turn depends for its existence on a supply of carbohydrates (sugars) which are the first products of the green leaf. Hence, if there is a shortage of reserve foods in the plant the anthocyanin may fail to develop because of a lack of chromogen. This relationship may be roughly represented by the following formula: $CO_2 + H_2O +$ chlorophyll + light and temperature

$$\longrightarrow \text{sugars} \longrightarrow \begin{cases} \text{glucosides} \\ \text{chromogen} \end{cases} \longrightarrow \begin{cases} \text{anthocyanin pigments} \\ \text{red color.} \end{cases}$$

This relates the whole problem of color back to the nutritional condition of the tree, together with favorable sunlight and temperature. So long as the nitrates entering the plant unite with practically all the available sugar to form proteins there will be no accumulation of carbohydrates from which chromogen is formed. This is the situation in trees making excessive growth and producing fruit of poor color.

Fletcher (*1*) and Gortner (*3*) both give evidence that the artificial "feeding" of plants with sugars has resulted in anthocyanin formation. The former applied 10 to 20 pounds of "Cerelose" per tree to apple varieties of York Imperial, Rome Beauty, Williams and Summer Rambo. Where 20 pounds of sugar and nitrate of soda were applied to the tree there was a development of 67 per cent of "solid blush" that was very clear and bright, as compared to the control trees which showed 34 per cent red color that was "rather dull". Where nitrate was omitted the effect of the sugar was less pronounced.

Relation of Leaf Area to Color

It would follow then that a tree with insufficient leaf area to properly mature its crop would produce fruit of relatively poor color, since the sugars are produced in the green parts. This situation has been produced experimentally by Magness (*5*) in the State of Washington. We take the liberty of using the following data from his work.

Table I,—*Relation of leaf area to sugar content and color. Delicious apples, Wenatchee, Wash., 1928. from Magness (5).*

No. of leaves per apple	Sugar Content, Percent			Solid Red Color Average Percent of Surface
	Reducing	Non-Reducing	Total	
			10.06	
10	9.19	0.45	9.64	23
20	10.23	1.01	11.24	
	8.96	2.12	11.08	26
30	9.96	1.51	11.47	
	9.20	2.44	11.64	42
50	10.11	3.07	13.18	
	9.62	3.60	13.22	51
75	10.84	3.29	14.13	
	9.92	4.86	14.78	58

An increase in color is developed as the number of leaves per apple increases, according to table 1. Therefore, up to a certain point, the more leaves the higher the color, provided they do not excessively shade the fruit. That excessive crops are poorly colored has frequently been observed. We recall an experience some 20 years ago when some thinning work was carried on in the orchards of W. W. Farnsworth near Toledo, Ohio. The heavily thinned Grimes Golden trees developed apples of a golden yellow color and frequently with a pink blush on the exposed cheek, while the adjacent trees bearing a very heavy crop were small and greenish in color, indicating an insufficient supply of organic material in the latter.

These observations may be supplemented with some recent ones at the Ohio Station when in 1929 C. W. Ellenwood conducted some thinning tests in a Jonathan block. An unthinned tree produced 1005 pounds of fruit and the fruit from this tree showed 61.55 per cent with sufficient red color to meet the U.S. standard for Fancy grade. The apples on an adjoining tree were thinned to 14 inches apart so that the tree bore only 623 pounds of fruit. There were 87.27 per cent of them Fancy in color. Another pair of trees were each thinned to 10 inches apart. One tree bore 840 pounds and the other 394 pounds. The one with the heavier crop had 68.17 percent and the other one 93.58 per cent Fancy. Many other data could be cited to support the contention that a limitation of sugars, however it is brought about, is likely to result in a lack of red color even though the amount of sunlight is in no way limited.

Fruit is also likely to be lacking in good red color in a season of excessive drought. Surely in such a season there is plenty of sunlight but some other requirement is lacking. Both the over-ladened tree and the one under excessively dry conditions produce fruit that is low in sugar and hence is low in color.

Light as a Factor in Color

For many years horticulturists were likely to say that red color was due entirely to the exposure of the fruit to sunlight and as evidence it was pointed out that shaded fruit was poor in color. There is so much truth in that statement that it is not at all strange that a more thorough analysis was slow in developing. Red color in apples, pears and peaches requires presence of sunlight on the fruit for there is no increase of it in storage. On the other hand the strawberry, cherry, blackberry, and grape will develop anthocyanin without the presence of light. (6).

In experiments in which apples were covered with black bags through which no light was transmitted no red color developed except on Williams Favorite. Furthermore, it has been shown that it is the blue end of the spectrum which is responsible for the development of the red color. Magness detached apples from the tree after they were developed but uncolored and placed some under glass which screens out much of the ultra violet rays. A sample was also exposed to direct sunlight. The following condensed table shows the great reduction in red color after twelve days when the violet rays were screened out of the light reaching the apples.

TABLE II.—*Color development of detached apples under glass and in direct sunlight. From Magness (5).*

VARIETY	Percentage of Solid Red Color					
	When Started		After 5 days		After 12 days	
	Under glass	Full Sunlight	Under glass	Full Sunlight	Under glass	Full Sunlight
Jonathan	6.8	8.6	10.5	37.7	44.0	96.0
Delicious	4.5	5.4	5.6	24.2	17.3	74.0
Rome Beauty	2.5	2.0	4.0	8.0	9.3	36.3

Magness states that color develops only one-fourth as fast under glass as in direct sunlight. In this connection it should be remembered that much of the ultra-violet rays are screened out of the light at low altitudes by dust, smoke, and other particles. At high altitudes this is not true and the colors of flowers and fruits are known to be much higher under such conditions.

Therefore, light is an indispensible factor in the development of color pigments in the apple, but only after there is a development and accumulation of certain sugar derivatives.

RELATION OF COOL WEATHER TO COLOR

It is a common experience to see fruit turn red when the cool nights of autumn arrive and the statement is commonly made that cool weather produces red color. However, experiments in which fruit was placed in a low temperature at night and exposed to sun during the daytime did not result in near so good color as fruit held at 70° instead of at 32°F. Despite this fact experience would indicate that high color and cool weather are at least correlated.

EFFECT OF FERTILIZERS ON COLOR

That aplications of nitrogen or excessive cultivation frequently reduce color is well known to the experienced orchardist. The explanation should be clear from the discussion earlier in this paper. As a result of denser foliage and proportionate reduction of reserve carbohydrates the fruits develop little color. Such apples are much more prone to scald in storage than well colored fruit, although this trouble can be greatly reduced by wrapping in oiled papers.

The chief question which is raised, however, is as to the value of potassium, phosphorus and iron in producing a better color. This question has been under discussion and experiment for many years and somewhat contradictory results are reported. Most of the data offered so far show no advantage to color by the use of these elements or a complete fertilizer. Of course if nitrogen is withheld the growth and yield are likely to be markedly reduced and the color improved but that is a poor solution of the problem, for both growth and yield are adversely affected. In general a fruit that is high in protein and low in carbohydrates is likely to be of poorer color than one in the reverse condition. It becomes a question of a compromise between the amount of growth and yield desired on the one hand and the color of the fruit on the other.

Thinning as an Aid

As stated before it is to be expected that thinning the crop will usually increase the color, both of apples and peaches. The physiological explanation would seem to be the same as that already given, namely, an increase in the supply of storage sugars to the remaining fruits. This would seem to be a better postulate than an increase in exposure to sunlight. Whatever the explanation, it is a practical method of solving the color problem as well as desirable from other standpoints.

Surface Quality of the Fruit

As a third consideration in the matter of grades we must give brief consideration to the matter of surface "finish" or quality. In this we would include freedom from blemishes, such as those caused by fungous diseases and insects, from limb rubs, and russeting caused by caustic sprays.

A clear, bright, smooth finish is paramount, for unless the fruit be clean it cannot be packed into the better grades. Yet fruit may be entirely free of blemishes caused by insects and diseases and yet fail to qualify for the superior grades that bring the grower the larger profits. This may be due to under-size, poor color or russetting.

In this regard we do not make any suggestion or recommendation as to spray practice in Nova Scotia or anywhere in Canada but cite our Ohio experience in attempting to reduce spray burn both of fruit and foliage. True we do not always have an option as to the spray to use, depending upon the nature of the troubles that must be controlled. In the main we have discarded bordeaux mixture as a spray in Ohio. There are certain exceptions to this statement but in general this is true. It was discarded because of the injury to fruit and foliage that frequently attended its use and not because of its inefficiency as a fungicide. Lime sulphur took its place and was used for some twenty years pretty much without change.

About eight years ago the Ohio Station undertook a series of experiments in attempt to reduce spray injury and improve the grade of fruit produced. F. H. Ballou (*1*) particularly interested himself in this problem. Four changes in the spray practice in Ohio have come about as a result of this work or are in the process of being realized. First, there is a reduction in the quantity of ingredients used per unit of spray solution. Both bordeaux mixture and lime-sulphur solutions were diluted and without a reduction in control of pests where the work was thoroughly done. Bordeaux is used as weak as ¾ pound copper sulphate, 2¼ pound high grade calcium lime to 50 gallons of spray material. Lime sulphur solution was reduced from 1 gallon of the solution to 40 gallons of water to 1 to 80, and with good results. A second change is in the use of dry lime-sulphur in place of the liquid. This has resulted in excellent control of the fungous troubles with which we usually must deal and has given a better finish to the fruit. A third innovation is the addition of five pounds of high grade calcium lime to 50 gallons of lime sulphur spray solution. This has materially reduced injury to the fruit and given a better finish and color to the fruit. The fourth result of this effort is the use of dust in place of sprays. Dust usually gives a better finish, reduces russetting and often gives a slightly better color. Dusting is

not recommended as an orchard practice to the exclusion of spraying in Ohio. However, progress is being made and it is likely to develop into a general, or at least a supplementary, treatment of all foliage sprays.

In conclusion we must say that there is no shortcut formula that will guarantee high color. Withholding of excess nitrogen or other practices that stimulate growth, reduction of yield by thinning, a moderate pruning practice, avoidance of caustic sprays that russet the fruit, and finally the use of red varieties, particularly red sports or strains of the old varieties, all contribute to a solution of the color problem.

LITERATURE CITED

1. Ballou, F. H. Reducing injury to fruit and foliage by proper selection of sprays. Proc. Ohio State Hort. Soc. p. 80. 1930.
2. Fletcher, L. A. A preliminary study of the factors affecting the red color on apples. Proc. Amer. Soc. Hort. Sci. p. 191. 1929.
3. Gaston, H. P. Why a cull apple is a cull. Mich. Agr. Exp. Sta. Sp. Bull. 160. 1927.
4. Gortner, R. A. Outlines of Biochemistry, p. 616-631. John Wiley & Sons, Inc., New York. 1929.
5. Magness, J. R. Observations on color development in apples. Proc. Amer. Soc. Hort. Sci. p. 290. 1928.
6. Overholser, E. L. Color development and maturity of a few fruits as affected by light exclusion. Proc. Amer. Soc. Hort. Sci. p. 73. 1917.
7. Onslow, M. Wheldale. The Anthocyanin Pigments of Plants, Second Edition, Revised. The University Press, Cambridge. 1925.

ERRATUM IN OCTOBER ISSUE

In the October 1930 issue of *Scientific Agriculture* (Volume XI, No. 2) the article entitled "Livestock Cycles in Canada," by Professor E. C. Hope, page 93, in the last paragraph the sentence beginning, "Due to the change in the world level, etc., should read, "Due to the change in the world level of all prices beef cattle prices at the bottom of the swing of the present cycle will probably reach the level of 1924. The sentence following should read, "Due to the restricted demand hogs reached the peak of the cycle somewhat sooner than the writer anticipated.

THE RELATION OF NITROGEN TO THE STORAGE QUALITY OF FRUIT *

J. H. Gourley †
Ohio Agricultural Experiment Station, Wooster, Ohio, U.S.A.

The subject under discussion is admittedly a controversial one and sufficient evidence is not at hand to answer the questions involved with finality. Yet so important is it to the fruit growing interests of America that a resumé of the information to date may be useful.

For some twenty years the prevailing fertilizer practice of American orchardists has been the use of inorganic nitrogen only, although most experiment stations have recommended that superphosphate be applied to the land between the trees, whether it is in sod or cultivated. This latter recommendation has not been stressed sufficiently, however. Throughout this period there have been some professional horticulturists and some fruit growers who dissented from the usual advice and urged complete fertilizers for orchards generally. Chemists and soils experts have usually advised complete fertilizer, reasoning from their experience with other crops. Hence orchardists stand practically alone in their assumption that nitrogen will give as satisfactory results as complete fertilizer with fruit trees. As in all other matters, the case should be decided upon the evidence secured from experiments, and an open mind should be maintained, for soil exhaustion may occur and local conditions may vary the crop requirements.

Varying Opinions

As a background we may cite the opinions of a few of those who hold varying views upon this subject, aside from those found in the scientific literature.

In a recent number of Better Fruit, McCollum (6) says "the continued use of it [nitrogen] alone will prove its insufficiency in the near future. . . The use of *small* applications of phosphorus and potash, and in a good many cases the method of application, places these plant foods at a distinct disadvantage from the outset." He cites some demonstration work recently carried on in Virginia which shows with certainty that a complete fertilizer gives the highest yields. Nitrogen and potash, and nitrogen and phosphorus show better responses than nitrogen alone."

A letter from an experienced orchardist in the state of Washington (1928) states that—

> "In our district we have used cover crops continuously in many of our orchards since 1920. In addition, great quantities of barnyard fertilizer have been applied and we have built up the nitrogen content of our soil many times over that carried by virgin soils. Gradually our keeping quality, together with color has been falling down each

*Presented to the Horticulture Group of the C.S.T.A. at the tenth annual convention at Wolfville, N.S., June 25, 1930.
†Chief, Department of Horticulture.

successive season until at present the matter of internal breakdown on Jonathans is quite serious, also the color which of course affects the grades of our fruit as it is packed out are very materially lowered over what they were when the orchards were young. We believe we have secured some very favorable results with the use of phosphorus and potash on the types of soils mentioned above."

Another letter from a horticulturist in that state (1929) says:

"Some storage work was done on fruit from different fertilizer plots in 1920-21 and 1922, and again in 1925-26, and 1927. In no case did we find that the fertilizer had modified to a measurable degree the keeping quality of fruit produced.

In several irrigated orchards nitrogen fertilizers did give a marked improvement in tree growth followed by a distinct increase in crop production. The crop produced was not distinguishable when taken from plots that had received nitrogen fertilizer only or from those that had received a complete fertilizer."

Still another from the Director of a Central States experiment station expresses the opinion that—

"Potash has a rather important influence. We have no definite information on that question other than some work with peaches where there was a very marked influence on the shipping quality. Strawberry growers in many sections feel that potash in particular has a very noticeable effect on the keeping qualities of the fruit."

One experienced worker says that:

"We know that in general large size fruits do not hold as well as medium or small size fruits and that nitrogen fertilizers have a tendency to increase the size when sufficient moisture is available, but I feel that we have practically no evidence, one way or the other, relative to the value of "complete" fertilizers as compared to nitrogen only in improving the storage quality of the fruit."

Literature

It is only comparatively recently that experimental work along this line has been reported, and it is not entirely in agreement. Archbold (*1*) analyzed apples from different localities and reports that "Most of the nitrogen is accumulated during the two months immediately following "setting" of the fruit, and this rapid intake of nitrogen is probably associated with the cell division which occurs at the same time. Starch and acid accumulation are found to be closely associated, and both follow the time of maximum nitrogen storage; the synthesis of starch and production of acid thus appear to be closely related in these apples." Further, he states that—"In all the apples examined high dry weight, high total sugar, and high sucrose values were found associated. In Bramley's Seedling from different orchards in the same locality nitrogen and sucrose were found to be inversely related, while in Worcester Pearmain the relation was direct. The difference in behavior is

attributed to differences in metabolism due to the widely different acid contents of the two varieties." Storage studies are not included.

Haynes and Archbold (*5*) suggest that "The properties which favor keeping have been found to be: low nitrogen and high sucrose, and probably also a large amount of cell-wall material."

Weinberger (*8*) investigated the effect of potash on keeping quality of various fruits and reports that "So far, under various soils and climatic conditions in Maryland, the use of potassium fertilizers, whether alone, in combination with nitrogen, or with nitrogen and phosphorus, has not affected the firmness or keeping quality of apples, peaches, or strawberries."

Degman (*2*) working in the same state finds that "the application of nitrogen fertilizers has caused no consistent change in the keeping quality of apples or peaches, as indicated by pressure tests and storage counts. . . However, there seems no doubt that when orchard practices, as pruning, soil management, thinning, irrigation, etc., are unwisely administered in connection with the use of nitrogen, resulting in the production of excessively large fruit, or when immature fruit is harvested, there will be a decrease in keeping quality, which is often incorrectly ascribed to the use of nitrogen."

Magness and Overley (*7*) working in the state of Washington find "no significant variation in the rate of softening as measured by the pressure test which could be attributed to fertilizer treatment."

While all of this work is significant and suggestive it is a question whether it has been carried on for a long enough period to answer the question finally. It is quite conceivable that the situation may vary under humid and irrigation conditions, under tillage and sod culture systems, and the many other variable conditions under which fruit is grown.

Results in Ohio

In the hope of throwing some light upon this vexing problem of "breakdown" or premature softening of apples, the writer laid out a series of experiments at the Ohio Experiment Station in 1927, although some preliminary observations had previously been made. (*3*). Orchards in sod and tillage were used, and several varieties included.

Physiological breakdown has not been common in the Station orchards although in 1929 it was quite prevalent. The trouble varies somewhat in its characteristics but consists essentially in a softening of the cortical tissue of the apple. Often it begins with a darkening of the vascular tissue adjacent to the carpels. The pith region often darkens and softens also, followed by irregular softening just beneath the skin. Sometimes the flesh softens quickly throughout without the previous darkening in the region of the carpels. We do not wish to create the impression that physiological breakdown does not occur nor minimize its seriousness. It is rather a question of what causes the trouble, and of seeking a remedy.

Figure 1. Typical breakdown in Jonathan apples. Note softening of cortical region and darkening of carpillary bundles.

Storage Results

The chief interest of the orchardist in this connection is in the behavior of fruit in storage. If samples from one treatment behave differently from those of another some clue may be given as to the cause. Consequently we have taken from one to three bushels from each treatment and held them in a well constructed common or air-cooled storage and the individual apples were examined periodically through the storage season. Shriveling, scalding and decay from other causes are also recorded, but the chief interest has been in physiological breakdown.

As will be seen below there is a striking difference in the nitrogen content of fruit which has been treated with nitrogenous fertilizer, yet the storage data indicate no measurable difference between lots which have not been fertilized at all and those which have had heavy applications. This is not in line with certain experiments which have been run elsewhere with such crops as celery and other succulent vegetative parts. As a matter of fact our observation has shown that it is the most highly colored fruits of such varieties as Jonathan and Stayman Winesap which show the earliest and greatest amount of breakdown. These highly colored apples would represent those high in sugars and other forms of carbohydrates in contrast to those that are not so well colored which would be likely to analyze proportionately higher in nitrogen.

While an effort was made to select typical fruits free of blemishes, punctures, bruises, etc., it was found that some of these blemishes were included, or that slight injuries occurred in handling the fruit during the storage season. In such cases storage decays and storage rots were likely to follow, and such results should not be correlated with the cultural treatment of the fruit. With early varieties, such as Wealthy, there was considerable decay before the end of the storage season while with such a winter variety as Stayman but little decay occurred. The following data on Wealthy and Stayman will show these results as carried on during the period of investigation. The Wealthy are young trees and are cultivated while the Stayman are older trees and grown in sod.

TABLE I. *Storage Results, 1928-1929, with Fruit from Cultivated Orchard, Planted 1922.*

Treatment	Plot	Per Cent Sound		Per Cent Shriveled		Per Cent Decay		Per Cent Scalded	
WEALTHY		Oct. 17	Nov. 14	Oct. 17	Nov. 14	Oct. 17	Nov. 14	Oct. 17	Nov. 14
5¼ lbs. nitrate	1-9 trees	89.8	60.2	3.4	29.6	6.8	10.2	0	0
1¾ lbs. nitrate	2 "	91.9	69.8	2.3	16.3	5.8	13.9	0	0
Complete fert.	3 "	91.6	68.4	4.2	15.8	4.2	15.8	0	0
1¾ lbs. nitrate	4 "	86.8	62.8	7.8	26.4	5.4	10.8	0	0
Nit. & Super. phos.	5 "	91.6	79.4	4.6	13.7	3.8	6.9	0	0
1¾ lbs. nitrate	6 "	91.3	72.4	.8	10.2	7.9	17.4	0	0
Nit. & Mur. potash	7 "	95.3	68.4	2.0	21.5	2.7	10.1	0	0
1¾ lbs. nitrate	8 "	85.7	62.5	14.3	37.5	0.0	0.0	0	0
No fertilizer	9 "	84.1	64.6	6.2	19.5	9.7	15.9	0	0
Average of normal N.		88.9	66.9	6.3	22.6	4.8	10.5	0	0

TABLE 2.—*Storage results. Stayman Winesap, in sod, planted 1915. Per cent decay or breakdown.*

1927 April		1928 March		1929 April	
$NaNo_3$ lbs.	Decay %	$NaNo_3$ lbs.	Decay %	$NaNo_3$ lbs.	Decay %
2¾	1.6	3	4.1	3¼	0.0
		6	0.86	7	0.4
		8	0.7	10	0.5
		12	0.0	14	0.0
12	4.9	14	2.2	17½	0.0

CHEMICAL DATA

During the seasons of 1928-29 Dr. E. F. Hopkins made chemical analyses of the growing fruits from the various plots. A portion of these data have been published elsewhere (*4*). These tests included color of fruit, growth as expressed by average diameter and weight of fruit, moisture content, total nitrogen, catalase activity, respiration, soluble pectin and pH of the juice. During the second season these tests were supplemented by determinations on the specific gravity of the juice, total acid as malic, and reducing and total sugars.

The most striking results were obtained in the mature Stayman trees in sod. The summarized data for nitrogen analyses from these trees are given in Table 3, which show clearly that nitrate applications result in a marked increase in the nitrogen content of the fruits, whether this is expressed as the percentage on the fresh weight basis or as the grams of nitrogen per 15 fruits. In many cases this increase is well over 100 per cent. The amount of nitrogen in the fruit rose with increasing amounts of nitrate up to 8 pounds per tree, and further increase in the application did not result in a further increase in the nitrogen content of the fruit but in some cases resulted in a smaller increase. The data for 1929 show that the amount of nitrogen in the fruits from the control trees remains practically the same from July 30 on, while fruits from the nitrate-fertilized trees show marked increases throughout the season.

TABLE 3.—*Mature Stayman trees in sod—Nitrogen content. 1928-1929*

Row and Tree	Treatment lbs. $NaNO_3$ per tree	July 31		Sept. 6		July 9		July 30		Aug. 12		Sept. 5	
		% N	Gms N per 15 fruits	% N	Gms N per 15 fruits	% N	Gms N per 15 fruits	% N	Gms N per 15 fruits	% N	Gms N per 15 fruits	% N	Gms N per 15 fruits
H	None	.0339	.2231	.0192	.2542	.0350	.1827	.0311	.2747	.0275	.3070	.0217	.3016
A	1¾	.0308	.1979	.0234	.3673	.0439	.2546	.0338	.3434	.0309	.3706	.0232	.4566
E 2	6	.0444	.3422	.0297	.5043	.0470	.3083	.0449	.4881	.0469	.5920	.0323	.6105
E 3	8	.0505	.3829	.0297	.5159	.0764	.4309	.0481	.4868	.0581	.6863	.0363	.7078
E 4	12	.0428	.3931	.0295	.5364	.0593	.3920	.0440	.5162	.0480	.6896	.0412	.8158
E 5	14	.0414	.3457	.0260	.5182	.0659	.3941	.0418	.4677	.0483	.6892	.0363	.6844

Results of the catalase determinations are shown in Table 4. Comparison of these results with those shown in Table 3 shows a close correlation between the catalase activity and the percentage of nitrogen in the fruit. The catalase is uniformly lowest in the control and higher in the treated plots and with few exceptions increases as the nitrogen percentage in the fruit increases. With a decrease in the percentage of nitrogen for the larger nitrate applications there is a corresponding drop in the catalase activity. This furnishes an interesting confirmation of the nitrogen analyses, since in the work of Heinicke on leaves, catalase activity rose with increased nitrogen.

TABLE 4.—*Mature Stayman trees in sod—Catalase activity. 1928-1929.*

Row and Tree	Treatment lbs. $NaNO_3$ per tree	Cubic Centimeters of O_2 in 5 minutes						Averages 1929
		July 31	Sept. 6	July 9	July 30	Aug. 12	Sept. 5	
H	None	1.64	2.90	1.39	1.51	1.78	1.41	1.52
A	1¾	2.56	4.75	2.04	2.46	3.79	2.29	2.64
E 2	6	3.20	5.50	2.66	4.75	5.23	3.15	3.948
E 3	8	3.47	5.40	3.78	3.90	4.54	3.60	3.955
E 4	12	2.15	4.64	3.23	4.18	4.30	3.28	3.75
E 5	14	2.34	3.60	3.21	2.98	3.67	2.45	3.08

Though the differences in young trees in cultivation were not so great as those just discussed, they were consistent and rather marked as to the nitrogen content of the fruits. Of six analyses made at different times on fruit from Jonathan trees, an increase in the percentage of nitrogen of the treated over the control was shown in every instance and the grams of nitrogen per 15 fruits was greater in five of the six cases. Fruit from Stayman trees in cultivation also showd marked increase in nitrogen when the trees were fertilized for each of three samples taken in 1929. Two samples from McIntosh trees showed the same. The case of apples from Wealthy trees in cultivation is interesting. One sample taken in 1928 showed an increase of 46.0% in the percentage of nitrogen in the fruit of the treated row (5 ¼ lbs. per tree) over the control, or calculated on the basis of total grams of nitrogen per sample, 47.2%. The next season August 15,

1929, samples were taken from these same trees as follows: in the control row and from each of five trees in the treated row. The results, as given in Table 5, indicate an increase in the nitrogen in the fruit which is undoubtedly significant. The average weight of fruits is also considerably greater for the treated row, while the moisture content is somewhat greater.

TABLE 5.—*Wealthy trees in cultivation.*

Row	Treatment lbs. $NaNo_3$ per tree	Average weight 15 fruits grams	Average Moisture per cent	Nitrogen per cent (average)	Increase of treated over control per cent	Nitrogen per 15 fruits grams	Increase of treated over control per cent
18	None	2540	87.01	.0285 ± .0020	—	.740	—
2	5¼	2882	87.42	.0380 ± .0023	33.70	1.100	48.65

In general from these studies one may conclude that nitrates produce larger, less highly colored fruit with a higher water content, greater amount and percentage of nitrogen, and higher catalase activity. Determinations of pH, total acid, soluble pectin, and respiration showed no well-defined differences, while more analyses will be required to show the trend of soluble carbohydrates.

LITERATURE CITED

1. ARCHIBOLD, H. K. Chemical Studies in the physiology of Apples. Ann. Botany 42: 166. pp. 541-566. April 1928.
2. DEGMAN, E. S. Firmness and keeping quality of fruits as affected by nitrogen fertilizers. Proc. Amer. Soc. Hort. Sci. pp. 182-186. 1929.
3. GOURLEY, J. H. Fertilizers and cover crops for peaches. Proc. Ohio State Hort. Soc. pp. 55-56. 1926.
4. GOURLEY, J. H. and E. F. HOPKINS. Some relations of nitrogen to keeping quality of fruit. Proc. Amer. Soc. Hort. Sci. pp. 167-173. 1929.
5. HAYNES, D. and H. K. ARCHBOLD. Chemical studies in the physiology of Apples. Ann. Botany 42: 168. pp. 965-1017. Oct. 1928.
6. MCCOLLAM, M. E. What about complete fertilizers for fruit? Better Fruit 24: 11. pp. 22-23. May 1930.
7. MAGNESS, J. R. and F. L. OVERLEY. Effect of fertilizers on storage qualities of apples. Proc. Amer. Soc., Hort. Sci., pp. 180-181. 1929.
8. WEINBERGER, J. H. The effect of various potash fertilizers on the firmness and keeping quality of fruits. Proc. Amer. Soc. Hort. Sci. pp. 174-179. 1929.

SOME RESULTS OF THE POST-WAR DEPRESSION ON FARM ORGANIZATION IN CANADA*

J. E. LATTIMER†
Macdonald College (McGill University), P.Q.

INTRODUCTION

The more curious students of the nature and origin of the post-war surplus of farm products generally and wheat in particular have credited Canada with contributing largely to the present abundant and somewhat abnormal supply of the raw material of the staff of life. As this is undoubtedly the case, perhaps the expansion in Canada in this line of effort during what is generally termed the post-war depression in agriculture may be of somewhat general interest. No detailed examination is here proposed yet some fairly recent figures are available which may shed some light on just how and why this development has taken place and more particularly the change in methods which have resulted from the recent depression in the industry.

Even a superficial glance at recent development requires at least a brief historical background. It must be remembered that Canada comprises a number of geographic and economic units somewhat isolated from one another by physical barriers and varying widely both in adaptability to agriculture and in stage of development. There are really two Canadas to consider, one that of 1867 being only one-tenth the area now comprising the Dominion and settled partly during the time referred to by Sir John Seely in "The Expansion of England" as the century during which "we seem to have conquered and peopled half the world in a fit of absence of mind"‡(*1*) and the other the Canada of today which has been largely settled during the present century.

Date of settlement combined with adaptability of soil and climate and natural resources have developed two sections, one with a well established system of farming catering largely to domestic needs, the other youthful, sparsely settled and dependent to a great degree on distant world markets.

World markets have always been important to Canadian agriculture. The somewhat unstable world market requirements of farm products has compelled a certain amount of versatility in Canadian farming. The repeal of the corn laws in 1846 turned the attention of the Canadian farmer to a market nearer home which was secured for a time by the reciprocity treaty of 1854. The abrogation of that treaty in 1866 hastened confederation the following year and renewed the movement of farm products from west to east. Even after the termination of that treaty, however, Canadians, perhaps with a partiality toward exportation of raw materials, maintained a considerable export of barley in a southerly direction. The McKinley tariff of 1890 dealt a death blow to this trade and assisted the development of a cheese

*A paper read at the International Conference of Agricultural Economists at Cornell University, Ithaca, New York, U.S.A., August 18-29, 1930.
†Head of Department of Agricultural Economics.
‡Seeley, J. R., "The Expansion of England", p. 8—1883.

and bacon export trade, the former of which is still important, the latter somewhat spasmodic. The Canadian farmer has had considerable practice both during the past century and the present in adapting his operations to world market demands. With such training perhaps even the post-war depression should not have found him helpless.

Basis of Farm Organization

Abundance of land, adaptability of soil and climate and small population are perhaps sufficient reasons to account for the organization of farming in the newer sections on the basis of the production of an export commodity which could physically and economically enter world markets. The endeavor to equate natural resources with world market demands has recently been strengthened considerably by fairly heavy international financial commitments. Hence the question confronting Canadian farming and more particularly that of the newer sections as yet sparsely settled is not shall world or domestic markets be catered to—although this question is now being debated in some lines—but rather how may farming be organized and developed to retain and increase the proportion of the world market in some product adaptable *both* to the region and to international trade.

The importance of world markets to Canada in general and western Canada in particular indicates the necessity of adapting farm organization to world prices in such a way, if possible, as to allow some hope of profit. Declining world prices compel reorganization if the standard of living of the farmer is to be increased or even maintained. Reorganization of farming though continually taking place appears to be invariably a slow, tedious and somewhat painful process. The factors mentioned have compelled this reorganization to assume an accelerated pace.

Changes that have recently taken place should be of general interest in indicating what utilization of land has lately proven most profitable and what type of farm organization reveals at present the greatest vitality and hence the greatest prospect of survival.

While no detailed study is here proposed there is available some evidence of changes of far reaching significance which indicates how farmers have modified their practice to meet the changed conditions confronting the industry during the last decade.

Utilization of Land

That part of Canada known as the prairie provinces cultivates annually at the present time about two-thirds of the area devoted to field crops in the Dominion. That area approaches but has not yet quite reached sixty million acres annually. With around sixty million acres devoted to field crops in the year 1929 over twenty-five million acres were devoted to wheat. All but about one million acres of this crop was grown in the prairie provinces where particularly the less humid regions enjoy peculiar advantages in wheat growing. In the eastern and northern regions of more generous rainfall these advantages are shared with coarse grains. How the expansion of wheat growing has taken place

during the past 60 years as well as during the past decade is presented in Table 1 together with the farm price per bushel and the index number of wholesale prices.

TABLE 1.—*Wheat in Canada 1871-1921* (2)

Year	Millions of acres	Millions of bushels	Value Millions $	Farm Price per bu. $	Index Number 1913 = 100
				(3)	(4)
1871	1.6	17	17	1.00	124.5
1881	2.4	32	39	1.20	109.9
1891	2.7	42	32	0.76	91.4
1901	4.2	56	36	0.65	84.5
1911	8.9	132	105	0.80	95.0
1921	23	301	243	0.81	171.8
1922	22	400	339	0.85	152.0
1923	22	474	317	0.67	153.0
1924	22	262	320	1.22	156.2
1925	22	395	488	1.23	160.3
1926	23	407	442	1.09	156.2
1927	22	480	478	1.00	152.6
1928	24	567	451	0.80	150.6
1929	25	300	347	1.16	146.0
1930	25	—	—	—	136.5

Dominion Bureau of Statistics.
(2) Canada Year Books, 1929, Statistical Summary, pages 26-27.
(3) Monthly Bulletin Agricultural Statistics, Jan. 1923-1930.
(4) Prices and Price Indices 1913-1928, p. 22.

Figures on wheat production and value are simple to present in a table, as bushels and dollars are fairly comparable over a period of years. The first comparison that we would direct your attention to is the farm price per bushel. Over the approximately sixty year period, here somewhat sketchily portrayed, there is apparently no very definite long time trend notwithstanding somewhat violent fluctuations from year to year. That the price per bushel was one dollar in 1871 and considerably less than that today might lead one to suggest that the tendency is downward. Other years taken into consideration might lead to a somewhat different result. What is perhaps significant is that since 1881 the price has shown a tendency to decline as acreage increased and that period approximated the advent into the industry of the grain binder.

It is when we take into consideration the change in the value of money during the interval that we are compelled to concede that the tendency of the real value of wheat—the amount of goods it will exchange for—is declining materially. In 1881 wheat was worth $1.20 per bushel when the index number (1913 base) was 109.9 while in 1924 and the following year the price was about the same per bushel while the dollar was only about two-thirds as valuable. In the year 1911 wheat was worth 80 cents per bushel and in 1928 it was the same price. But in 1911 the index number was 95.0 while in 1928 it stood at 150.6 showing that the real value of wheat was only about two-third that of 1911 as it required a bushel and a half of wheat to secure the amount of other goods that one bushel secured in the earlier year.

Efficiency of the Wheat Grower

No definite long time trend is discernible in the farm price per bushel of wheat in over half a century. And this notwithstanding that money in the meantime has become less powerful. This bears eloquent testimony to the increased efficiency of the wheat grower. An industry which has, during the period, been able to sell its product at a similar or lower price per unit challenges comparison in respect to its efficiency. Further, such an industry may point the way to some industries which, by enhanced prices, have lost ground through the competition of substitutes. That the acceptance of the comparatively low price for wheat has been from necessity rather than voluntary we shall later note. In the meantime the important point is the comparison existing.

Considering more closely the post war decade a steady downward trend in price is apparent for the last half of the decade. It has been during this time that stocks have been accumulating. The carry over of wheat at the end of the crop year in Canada was less than twenty-five million bushels in 1925. Since that time, however, the carry over has increased annually, being some seventy-eight million bushels at the end of 1927 crop year and over one hundred million for the two last seasons. It is claimed that the reservoir of wheat formerly assured by the grain trade of Britain, a trade now somewhat disorganized, is not provided by the miller.*(5). If this be correct, storage will necessarily be provided more largely by the grower.

It is essential that we should concede the importance of the tendency of farm products to decline relatively in value. It appears that the fear of a development in the opposite direction was one potent reason for earning for the subject we are interested in the name of the dismal science. That fear has by no means entirely disappeared and many anticipate a sellers market for farm products at some no very distant date. If the tendency is downward this fact should have some influence on our policy of storing. We have noted that the increased carry over has developed with and during the decline in price. Storage under such circumstances is not a remunerative business as the trend during the last half of the decade in this particular commodity is decidedly against the disciples of Joseph.

Production and Price

Total production and total value afford a useful comparison during the years of the past decade. Three times during the period, namely, in the years 1923, 1926 and 1928, have larger crops secured less cash. In 1924, 262 million bushels proved more valuable than the previous harvest of 474 million bushels. The fact that small crops have sometimes brought greater returns has led some to the conclusion that all that is necessary to secure a sellers market is to produce a small crop. These figures, however, do not support such a conclusion. Both in 1922 and in 1925 increased production coincided with a higher price while both last year and the present season prove that it is possible with a commodity so largely dependent on world markets to have small crops and low prices at one and the same time.

*Hurst, A. H., "The Bread of Britain", pp. 54-57. Oxford University Press, 1930.

Perhaps the most important point in the record as presented in this table is the influence of price on production. Our attention is often directed to the influence of production on price but rarely do we see much emphasis placed on the influence of price on production. The acreage given in round numbers of millions of acres does not present the fluctuations which actually occurred. Even allowing for this the acreage presents a stability which is somewhat surprising considering the vagaries of price. Apparently prices of one or two years have no very great influence on acreage, the low price of 1923 did not reduce the acreage the following year nor did a price almost twice as high per bushel in the following year expand acreage. With the farm price of wheat 67 cents and $1.22 the acreage remained about normal. This probably would not occur in sections where wheat growing is carried on as a side line. But it is explained for sections where wheat growing is more of a specialty by the fact that farms are organized for growing wheat: when wheat is low in price other grains are lower and alternative opportunities less attractive.

It is over longer periods of time that the influence of price on production is clearly indicated. The comparatively low prices of 1921 and the two following years though not decreasing production perceptibly certainly prevented any expansion. The four years from 1924 to 1927 inclusive, years of dollar wheat or more at the farm, resulted in the expansion of acreage in 1928 and since that time. A price which ensures an abundant supply is certainly an adequate price. In various endeavors to stabilize price this simple fact appears to be frequently lost sight of.

Expansion of Wheat Area

The recent expansion in area devoted to wheat in the prairie provinces has not been attributable to any great degree to the expansion of total area but has been partly due to a shift from other crops. Wheat, oats and barley are the crops which occupy the bulk of the area under consideration. A comparison of the areas of these crops with the total since 1920 follows:

Table 2.—*Prairie Provinces** (3)
(Figures in Millions).

Year	Area in Wheat, oats barley, rye and flax.	Wheat	Oats	Barley
1920	31	17	10	2
1921	37	22	11	2
1922	34	21	9	2
1923	34	21	9	2
1924	35	21	9	3
1925	31	20	7	3
1926	34	22	7	3
1927	34	21	8	3
1928	37	23	8	4
1929	38	24	8	5

* Monthly Bulletins Agricultural Statistics.

An examination of the figures showing the utilization of the cropped land during the decade indicates clearly at least three significant movements, first, that there has been no very rapid increase in total acreage during the decade, second, that the increase in barley is almost balanced by the decrease in that devoted to oats, thus leaving wheat the opportunity of absorbing the bulk of the expansion of acreage occurring.

Expressed in percentages, wheat, which comprised 55% of the total devoted to the chief grain crops in 1920, in 1929 comprised 63.2%, and has run over 63% for the last half of the decade. Oats, accounting for 32.9% of the acreage in 1920, by 1929 has decreased to 20.1%, while barley, during the period, increased its proportion from 6.0% to 13.6%.

Apparently during the decade wheat has revealed the greatest tenacity in the competition of the survival of the fittest. The increase in area devoted to this crop is not entirely due to bringing in new land but is partly on account of the greater proportion of the land being cropped to wheat than formerly. This is not entirely on account of the advice given the grower. It is easy, however, to connect this with price and with the interim payments of the pool being 70 cents per bushel for wheat, 30 cents for oats and rye and 25 cents for barley during the current year a switch away from wheat growing is not at present imminent.

Wheat, perhaps on account of its importance in international trade, displays a tendency to monopolize the attention of the public. We hear much of the carry over of wheat but little of the present carry over of barley and rye which is at present perhaps a source of greater worry to the grain trade. Obviously there are other more important methods of disposing of coarse grains than direct sale and this brings us to the question of the expansion of the production of live stock and live stock products.

Value of Wheat and Dairy Products

Wheat also receives usually major consideration in any discussion of Canadian farm production. There are other important lines of endeavor; a comparison of the values of wheat and dairy products is of special interest because seldom made.

Table 3.—*Values in Millions** (2) (3)

	Wheat	Dairy Products
1871	17	15
1881	39	23
1891	32	30
1901	36	66
1911	105	103
1921	243	205
1922	339	198
1923	317	230
1924	320	218
1925	488	241
1926	442	250
1927	478	254
1928	451	297
1929	347	293

* Figures from Canada Year Books and Monthly Bulletins Agricultural Statistics.

Over long periods dairy products have been almost as valuable and increasing almost as rapidly as wheat production, though attracting much less attention. During the four years from 1925 and 1928 inclusive a series of larger than average yields combined with higher than average prices gave wheat a value almost double that of dairy products for the period. The year 1929 (and 1930 probably) with less than average yield of wheat combined with lower prices has, however, brought wheat and dairy products again within comparable range in aggregate value.

During the half decade 1921-26 in the prairie provinces census figures record an increase of 69,577 milk cows, a gain of 6.6 per cent and in hogs a gain of 565,130, a gain of 53.6 per cent, while the wheat acreage increased by 2,415,661 acres, a gain of 12.5 per cent.

Increase in Size of Farms

Perhaps even more interesting than what has been done is the method followed. During the half decade the number of occupied farms in the prairie provinces decreased from 255,651 to 248,162, a decrease of 7,489 or 2.93%.*(*6*) (*7*) (*8*). The decrease in number was greatest in Alberta, much less in Saskatchewan, while Manitoba retained practically the same number of farms in operation. The area in farms, however, increased during the period by one million acres in round numbers, the improved area by over four million acres and the cropped area by two and three-quarter million acreas. The average prairie farm comprised 344 acres in 1921, 175 improved and 126 cropped. In 1926 the average prairie farm reached 358 acres, 198 improved and 141 cropped. The size of the average holding increased in the five year period by 14 acres, the improved acres per farm increased by 23 and each farm cropped 15 acres more in 1926 than in 1921.

The average acreage devoted to wheat by the farms growing this crop in 1921 was 94.7 while in 1926 this was 102.9, an addition of over 8 acres per farm on the average. Adding this area to the wheat crop per farm during the interval, however, apparently did not prevent an increase in dairying and hog raising per farm as has been indicated.

The enlarged acreage during the post-war period of declining prices has enabled prairie farms to produce field crops more valuable in 1925 (and several succeeding years for that matter) in the aggregate than those of the war years when prices of farm products were much higher. That this was accomplished by fewer farms in operation than in 1921 means increased returns per farm.

The increased size of the farm as revealed by the 1926 census may be by now quite out of date and possibly is important chiefly as a matter of history as the mechanization of farming has received a great impetus from the introduction of the combine harvester since 1926. This indicates that the movement started during the first half of the decade is moving forward now at an increasing pace. Evidence of this is to hand in the lessened dependence on transient labour for harvest during recent years.

*Dominion Bureau of Statistics Census of Provinces, 1926.

Changes in Tenure

The number of farm owners decreased from 202,947 to 171,768 during the half-decade. The number of tenants increased from 27,067 to 40,261 and the part owners and part tenants increased from 25,643 to 36,133. An area of seven million acres was transferred from ownership to leasehold during the interval. The increased size of the farm might be expected under normal conditions to make ownership more difficult on account of the larger amount of capital required. This explanation does not fit however in this case as even the larger farms were less valuable in 1926 than were the smaller areas five years earlier, the difference being a decrease of $3,285 in value per farm in Manitoba, where the size did not increase, $2,409 in Saskatchewan and $1,428 in Alberta. Even with the increased size of the unit in the two latter provinces the total value or investment per farm decreased materially during the interval.

Unity of Tenacity

Census figures of 1926 record the number of vacant or abandoned farms in the prairie provinces (*6*) (*7*) (*8*). The total number was 19,108 comprising 3,801 in Manitoba, 4,907 in Saskatchewan and 10,400 in Alberta. The acreage amounted to 667,679 acres in Manitoba, 1,020,217 in Saskatchewan and 2,337,715 acres in Alberta, a total of four millions in round numbers.

Of these 19,108 farms 14,139 were less than 161 acres in size, 4,576 were from 161-480 acres and 393 were 481 acres or over. By comparing the number of vacant farms with those occupied we find that among the units of less than 161 acres approximately one farm out of seven vacant in the class from 161-480 acres, one out of twenty-five, while among those farms of 481 acres or over for every vacant farm there were slightly over one hundred occupied.

Apparently the units displaying the greatest degree of tenacity in this area during this period are among the larger classes. The tendency to desert the small areas is in accord with the increase in size of the farms noted in Saskatchewan and Alberta. It is also apparent in Manitoba where farms did not increase in size during this interval. The movement in Manitoba when smaller areas than the whole province is considered reveals a marked migration from the small and recently settled farms in the northern part of the province (Nos. *12* and *13*) to more hopeful prospects. Homesteads are generally 160 acres. Abandonment of recently settled homesteads means the abandonment of small areas. Proven regions have for some time past displayed a rather rapid tendency toward consolidation. The abandonment of small areas may be in some cases the giving up of land submarginal (perhaps temporarily) on account of the small area improved and lack of incentive to improvement under present conditions of the industry and it may be again on account of the unit being too small to be operated profitably under present conditions.

Whatever the cause the important point is that this condition exisits. We need not dwell on the cause or causes. Upon these we shall not be

liable to agree in any case as we do not appear to display any marked unanimity of opinion as to the treatment necessary. This lack of agreement as to treatment indicates that we are not certain as to the cause or causes. Exposition is what is attempted with the hope that this exposition may be interesting and perhaps useful to those who may be interested in the size of unit which has displayed the greatest tenacity during this time.

Whether this tendency is desirable or not is another point that need not delay us long at the moment. Almost everyone has pretty definite ideas on this point, ideas which are not kept secret. For this reason competition is pretty keen in the field of offering advice and proclaiming what should or should not be. On the other hand there apear to be fewer engaged in the work of exposition, competition less keen and therefore the task more inviting at present.

Exposition, however, is frequently all that is required to reveal cause. The decade just past witnessed declining prices and rising living standards. Greater returns were essential to secure the latter with small or negligible influence over the former. The problem was met by each individual increasing output. This is not the first time that this problem has been met in this way.

The decade from 1891 to 1901 was a period of depression in Canadian Agriculture which would perhaps by comparison make the past ten years appear prosperous. A period of declining prices and increasing use of farm machinery resulted in an actual decline in the numbers engaged in the industry during the decade. The census of 1891 recorded 735,207 farm workers, that of 1901, 716,860 while during that time the occupied land increased by four and a half million acres, the improved area by two and a half million and the cropped area by four million acres in round numbers. The average size of the farm increased during this decade from 98 to 125 acres.

The decade from 1901 to 1911 was not one of declining prices. It was, however, a period of rising standards of living and increased mechanization of farming. During this time the tendency toward abandoning farms in some of the older provinces appeared. This tendency was considered of sufficient importance or seriousness to secure attention in the census of 1911. The number of vacant farms classified according to size was recorded.

TABLE 4.—*Vacant Farms Eastern Canada*
1911* (9)

	5-10 ac.	11-50 ac.	51-100 ac.	101-200 ac.	201 ac. and over
Ont.	522	1,903	1,554	581	199
Que.	84	236	215	93	37
N.B.	146	279	234	66	14
N.S.	219	418	218	104	32
P.E.I.	5	73	47	10	2

* Fifth Census of Canada, 1911, Vol. 4, Intro. p.xxx.

In every province the most popular farms to abandon were those between eleven and fifty acres in size, a class, by the way, which has never been numerous, the modal group being at that time the next larger class for all

provinces. This earlier record is cited as an indication that the trend of the past decade is not an entirely new phenomenon nor one confined only to the grain growing sections. Where the type of farming does not permit of modification and this is possible where population is small and markets distant, a rising standard of living for farmers demands increased individual production of the export products. This means in many cases increased acreage operated per worker.

Economic Force vs. Public Policy

Abandonment of the smaller areas indicates the elimination of the high cost producer and a gradual if perhaps slow and painful move in the direction of the rationalization of the farming industry. This tendency has resulted from the pressure of lower prices. This is the method by which society reaps the advantages of improvement in technique.

Two words have attained considerable prominence during the past decade. These are rationalization and stabilization. Rationalization refers usually to the industry and signifies the elimination of the high cost units from the industry. Stabilization on the other hand refers usually to price and where this is secured signifies retaining the high cost unit in the industry.

Stabilizing prices is naturally the most popular. Rationalizing an industry comes only with the pressure of economic force. The tendency for fewer farmers to supply the needed quantity of their goods has probably been viewed with a greater degree of alarm than the generality of business changes. While the migration of some of these farmers to more hopeful prospects than their first location has been assisted by provincial governments both in western and eastern Canada, the movement to enlarge the unit generally has been unsuspected by demos and without the sanction of public policy.

The trend has indeed met with considerable opposition from influential people who worry over the question of why the boy leaves the farm. This question might be examined. The latest figures available give the classification of the gainfully employed according to age and vocation as follows—

Table 5.—*Canada 1921** (10)

Age	Total Gainfully employed	Gainfully employed in agriculture	Percent
10-13 yrs.	7,729	6,257	81
14-15 "	50,345	30,261	60
16-17 "	112,050	56,311	50
18-19 "	132,771	58,331	44
20-24 "	324,102	124,751	38
25-34 "	663,919	219,675	33
35-49 "	845,278	292,374	35
50-64 "	421,158	172,777	41
65 and over	125,167	62,969	50
Total	2,683,019	1,023,706	38.2

* Canada Year Book, 1929, p. 140.

Of those gainfully employed of 25 years of age and less a greater proportion are employed in agriculture than the proportion of the total which agriculture is credited with. Of those from 25 to 50 the proportion is less. The answer to the question why does the boy leave the farm is that he does not. The question might be why does the man leave the farm? Naturally if those between the ages of 25 and 50 are still boys with farm boy's privileges the situation is somewhat self-explanatory.

Another common complaint among publicists is that Canadians of the present generation prefer other occupations to that of farming. The percentage native born to total for the different industries was reported in 1921 as follows—

TABLE 6.—*Canada* 1921* (10)

	Total %	Native born*(10) %
Agriculture	38.2	40.9
Loggers and fishermen	2.6	3.0
Manufacturing	15.5	14.5
Mining	1.9	1.4
Construction	6.9	6.6
Transportation	8.4	8.0
Trade	9.3	9.3
Finance	1.7	1.8
Professional	3.1	3.1
Service	11.2	9.9

* Canada Year Book, 1929, p. 147.

Canadian born males are more than proportionately represented in agriculture, logging and fishing and finance, under-represented in mining, manufacturing, construction, transportation and service, while in the other classification they appear to hold their own. Upon the assumption that too many of the "boys" leave the farm and that the native born prefer other occupations to that of farming, public policy has supported during the last decade an immigration policy stipulating that only those intending to enter agriculture should be encouraged to come to the country. This accounts for a reference in a recent book which discusses the mobility of labour to the agricultural complex of the colonial governments in regard to immigration* (*11*).

Meeting the depression in agriculture by fewer workers producing more prevents the industry from absorbing much labour. This method of meeting the difficulty has been largely from compulsion, the compulsion of the inevitable if unwelcome pressure of economic force. The trend illustrates how this force usually in the long run vanquishes public policy when they oppose each other and may be useful in case you *may* have difficulty in finding as suitable an example nearer home.

SUMMARY AND CRITICISM

The first post-war decade of agricultural depression discloses some interesting changes in farm organization in Canada. In the rearrangement

*Nisbet, J. W., "A Case for Laissez-faire", p. 56. P. S. King & Son, London, 1929.

necessary to retain world markets at declining prices and profits if possible at the same time several trends have been revealed.

The survival of the wheat crop in this period of keen competition, the increase in the size of the farm and the abandonment of the smaller units are plainly demonstrated. This indicates that the farming business is rationalizing itself similar to other industries. And by rationalization we mean the substitution of machine for man power, scrapping the inefficient plants and increasing the size of the superior plants to decrease the overhead. Apparently this is exactly what is going on, perhaps in a slow way, in farming judging by the evidence. The result has been that fewer workers are producing more. With declining prices present and prospective*(*12*), this appears to be the way to retain a profit. This method appears to have worked in the prairie provinces where the value of field crops in 1925 exceeded that of any of the war years of inflated prices. This method of meeting the depression appears to be not only the way but the only way.

Other methods have been proposed and even attempted by these same farmers. For instance we hear much of the need for and endeavor to stabilize prices. How can prices be stabilized without stabilizing inefficiency? We have noted that the inefficient units, the high cost producers, have been eliminated by declining prices. If this be the case, then, any success that might be attained in stabilizing prices would retain in the business the high cost producer. It is naturally not surprising that we have considerable clamor for stabilized prices more especially in wheat when we consider the remarkable stability of the price of bread**(*13*) but that is another matter. There appears small progress to report thus far from any endeavor to stabilize prices of farm products. In a country dependent on world markets the endeavor appears vulnerable on two points, namely, it appears impossible and if possible quite possibly undesirable.

It does not appear necessary to dwell for long over the question of the desirability of stabilized prices as for countries dependent on a world market stabilization appears impossible in any case. Adam Smith in his elaborate and exhaustive enquiry into the nature and causes of the wealth of nations said.†(*14*).

> "Whoever examines with attention the history of the dearths and famines which have afflicted any part of Europe, during either the course of the present or that of the two preceding centuries, of several of which we have pretty exact accounts, will find, I believe, that a dearth never has arisen from any combination of the inland dealers in corn, nor from any other cause but a real scarcity, occasioned sometimes perhaps and in some particular places, by the waste of war, but in by far the greatest number of cases by the fault of the seasons; and that a famine has never arisen from any other cause but the violence of government attempting by improper means, to remedy the inconveniences of a dearth."

*Bureau of Agricultural Economics, Washington. "The World Wheat Outlook", July 3, 1930.
**Bureau of Statistics. Prices and Price Indices, 1913-1928, p. 136.
†Wealth of Nations, Book IV, Chap. V.

When that was written it was deemed periodically expedient to endeavor to lower the price of food and farm products. Recently it has been deemed expedient to endeavor to raise them. The change in the direction of public policy is in itself significant. The results so far, at least for those countries dependent on world markets, have, however, apparently been no more successful than were those previously exerted in the opposite direction. Hence we might paraphrase the above quotation for—

> Whoever examines with attention the history of the periods of surpluses of raw materials and farm products which have afflicted any part of the world during the last decade, and of several of these we have pretty exact accounts, will find, I believe, that depressed prices have never arisen from any other cause but an abundant supply, occasioned sometimes by unnecessary expansion, but in by far the greatest number of cases by the fault of the seasons; and that a troublesome surplus has never arisen from any other cause but the violence of government attempting by improper means, to remedy the supposed inconveniences of plenty.

LITERATURE CITED

1. Seely, J. R., "The Expansion of England", p. 8. Roberts Bros., Boston, 1883.
5. Hurst, A. H., "The Bread of Britain", pp. 54-57. Oxford University Press, 1930.
11. Nisbet, J. W., "A Case for Laissez Faire", p. 56. P. S. King & Son, London, 1929.
12. Bureau of Agricultural Economics, Washington, The World Wheat Outlook, July 3, 1930.
14. Smith, Adam, "Wealth of Nations", Book IV, Chap. V.

REFERENCES

Dominion Bureau of Statistics.

2. Canada Year Book 1929, Statistical Summary, pp. 26-27.
3. Monthly Bulletins of Agricultural Statistics, Jan. 1923-1930.
4. Prices and Price Indices, 1913-1928, p. 22.
6. Census of Manitoba 1926.
7. Census of Saskatchewan 1926.
8. Census of Alberta 1926.
9. Fifth Census of Canada 1911, Vol. 4, Introduction, p. XXX.
10. Canada Year Book 1929, pp. 140 and 147.
13. Prices and Price Indices, 1913-1928, p. 136.

THE INTERNAL PARASITES OF POULTRY IN QUEBEC*

ALEX. D. BAKER†
Macdonald College (McGill University) P.Q.

The importance of the internal parasites of poultry is now pretty generally recognized, or should be. The subject is one of paramount importance to the poultry raiser.

During the past year or so the writer has been engaged in a study of the internal parasites of poultry as one of the research problems he has been carrying. Some progress has already been reported (*3*), and, more recently, a study was undertaken, through the assistance of the National Research Council of Canada, consisting primarily of a survey of the internal parasites of chickens throughout Quebec. In furnishing a few notes on this work, the writer wishes to emphasize that these studies are by no means complete. At least it may be said that this work is a beginning and should serve as a base line for future investigations. Some sections of the province have been covered fairly thoroughly and the west, south, and east borders given attention. Several of the central counties are as yet unstudied, but, with the distribution of any one species of parasite indicated on all sides of an unstudied county, the possibility of the presence of that parasite therein is indicated.

Nine different species of parasites will be discussed. These will be taken up in turn and notes given on each. As this paper is in the nature of a preliminary report, tables, distribution maps, etc., will be omitted, and the subject handled as briefly as possible.

Eimeria avium (Rivolta and Silvestrini, 1873)

This parasite is widely distributed throughout Quebec and is one of the major problems of the poultry raiser. It was located as far east as Montmagny, L'Islet, and Frontenac counties, extending south through Huntingdon county, west through Argenteuil and Labelle. Even though this study was made during the fall of the year, when young stock was not plentiful and the disease not so noticeable, it was found to be quite common in most of the districts examined.

It should be noted that in cases of acute coccidiosis of young chickens the causal organism is to be found largely confined to the caeca and the lower intestinal tract. Infection in older birds is often found occurring throughout various parts of the small intestine. A difference in pathogenicity is frequently noticed between the two types. Tyzzer (1927), believes coccidiosis in chickens appears commonly to represent a mixed infection. The form causing the acute injury may represent a distinct species. Tyzzer differentiates this by the relatively huge size of the schizonts, the large size of the merozoites, deep penetration of the tissues, pathogenicity, localization and type of development. A second strain (or species) of *Eimeria* produces only small schizonts and merozoites, which develop superficially in the epithelium of the

*This work was assisted by a grant given to Professor E. Melville DuPorte, for administration and general supervision, by the National Research Council of Canada, and was carried on in the Department of Entomology and Zoology at Macdonald College, P.Q.

†Assistant in Entomology and Zoology.

small intestine, without invading the caeca or producing hemorrhage. While the death rate with the latter type of coccidiosis is much lower than from the form occurring in younger birds, general disturbances of the bird's vitality are often evident. Stafseth (1929), has recently pointed to some cases of rickets as a secondary manifestation of coccidiosis.

Figure 1. Stained preparation from caecal lining of fowl infected with coccidiosis, (*Eimeria avium.*) Division of scale equals .01 mm.

Figure 2. Specimens of *Heterakis gallinae* taken from caecum of fowl. (Hand lens).

Ascaridia lineata (Schneider, 1866) Railliet & Henry, 1912

This is the common, and the most conspicuous, internal roundworm of poultry. This worm is normally found within the bird's intestine. Some slight wandering of the younger worms from the small intestine may occur and other tissues and organs become invaded. In such cases this migration must be looked upon as a somewhat abnormal condition.

The distribution of this parasite is apparently not confined to any particular section of the province, but is quite generally located throughout. Its western distribution extends through Argenteuil, Labelle, Hull and Pontiac counties. It is quite plentiful around the Island of Montreal and adjacent counties such as Laprairie, Chambly, Beauharnois, etc., with its area of distribution extending along the international boundary through Huntingdon, Stanstead, and Sherbrooke counties, and up through Montmagny, and L'Islet counties.

Birds heavily parasited with these worms show considerable distention of the gut, due to the lumen being so tightly filled with the worms. On opening out the intestinal tract, the walls show evidences of the tension to which they have been subjected by the speed with which they release their contents. Examination of the intestinal walls shows a compressed appearance, as if

the opened intestine had been rolled out flat. Direct injury to the wall itself has been noted. Heavy infestations of this species of worm are often associated with dirty, ill-kept poultry plants.

Where these worms are numerous the effect on the flock becomes very marked. Herrick (1923-6) found them responsible for retarded growth, muscular deficiency, general weakness and a mortality of 23% in young chickens. The most serious effects and the highest mortality are recorded as occurring during the third week of parasitism, when the attacks of the larvae upon the intestinal walls are greatest.

As chickens grow older, resistance to infection from this parasite increases greatly, until it may become almost impossible to produce infection no matter how exposed to these worm eggs the birds may be. This is an important feature and stresses the value of endeavoring to prevent or check infection during the earlier stages of the life of the bird. The experiments of other workers have shown the same results as recorded above (Herrick, 1926, and Ackert, 1926).

These worms usually reach maturity in about two months' time, and by the 60th to 76th days fertilization of the female worm takes place and it begins to lay eggs.

Heterakis gallinae (Gmelin, 1790) Freeborn, 1923.

To find a poultry flock in this province which is free from these worms is almost exceptional. They are usually located in the distal two-thirds of the caeca. Here they feed close to the walls, sometimes causing some damage to the epithelium of the caecal glands, although they may also be found fairly evenly scattered throughout the caecal contents. Usually the edge of the faecal material is where the greatest number of the worms will be found.

If these worms are not too numerous, they may complete their development without noticeable bad effects to the bird. Sometimes they occur in enormous numbers and injury becomes quite marked.

There are quite a number of other birds that these parasites will invade. A high infestation of turkeys with this worm is correlated with a high incidence of Blackhead (Graybill, 1921). The organism causing Blackhead of turkeys (*Histomonas meleagris*) may be carried over from one bird to another within the eggs of this worm. This parasite is thus of great importance as a carrier of the Blackhead organism. Tyzzer (1928) has located these organisms within the bodies of the worms. Chickens usually recover from Blackhead, but if they are not separated from the turkeys severe infection and loss of the latter may occur.

The life cycle of these worms is completed in 56-61 days after infective worm eggs have been swallowed.

Capillaria meleagris-gallopavo (Barile, 1912).

These worms are seldom observed by the majority of poultry raisers. The prevalence and injury has, in consequence, been left in doubt in the past. They very probably represent an important species of poultry parasite. The writer has found them in such widely separated counties as Hull, Beauharnois, Montmagny, Jacques Cartier, L'Islet, etc., in Quebec.

A condition of the bird's intestine, which the writer has found frequently associated with the presence of this worm, consists of ulcerous patches which may range from those the size of a pin point to those in which the diseased area has become greatly extended and hardened. The exact role the parasite may play in promoting this condition is not known. Its frequent association with this injury would seem to justify us in supposing that there is some intimate connection.

While these worms spend most of their life cycle free in the intestine, they are finally most frequently observed with the head end of the worm deeply penetrating the intestinal wall. By careful examination the free hinder end of the fine thread-like parasite may be observed extending into the lumen.

Amoebotaenia sphenoides (Railliet), Cohn.

This appears to be the first time that this tapeworm has been reported from Canada. Cram (1928) states that the species "is rarely found in chickens in this country, cases from Maryland and the District of Columbia apparently being the only ones reported to date." They were located in two places in this province but from widely separated regions (Pontiac and Kamouraska counties), which indicates the possibility of their being present in other flocks. In one case the infestation was quite heavy.

Our knowledge of the life history of this parasite is incomplete. Earthworms have been shown to play the part of intermediate hosts by Monnig (1926) in South Africa and by Grassi and Rovelli in Europe (species of *Allolobophora, Pheretima,* and *Ocnerodrilus*). Monnig was able to produce infection experimentally through *Ocnerodrilus* (*Hyogenia*) *africanus*, and reported the cysticercoids as developing in 14 days and the tapeworms in 28 days.

The worms are found attached to the walls of the small intestine and were noted to be most numerous in the region of the duodenum.

Davainea proglottina (Davainea, 1860), Blanchard, 1891.

This tapeworm is undoubtedly the cause of mortality and unthriftiness in a very considerable number of the poultry flocks in this province. It was found to be very widespread and surprisingly common. Due to their small size these worms have apparently been overlooked, and, in consequence, they have not had the results of their activities laid to their credit. I consider this worm to be one of the major pests of poultry in the Province of Quebec. The injury to the bird which can be caused by these parasites is very considerable. It indicates the importance of attention to this phase of poultry problems when it can be said that this parasite has been practically unknown to the great majority of poultry breeders in Quebec.

These tapeworms are usually very numerous when present. The mature proglottids become detached very easily and are capable of quite active movements. These isolated segments, except for the injury, are the most noticeable evidence of the presence of these worms. A mature proglottid is often as large as the remainder of the worm.

Figure 3. Microscopic view of eggs in body of *Capillaria meleagris*, showing shape and arrangement of eggs and the opening of the oviduct.

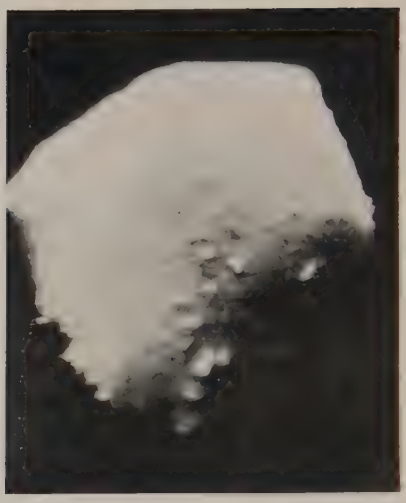

Figure 4. View of specimens of *Davainea proglottina* attached to inner surface of bird's intestine. (Hand lens.)

Figure 5. Scolex and anterior segments of *Davainea proglottina*.

Figure 6. Mature segment of *Davainea proglottina* showing eggs, remains of genital structures, etc.

Species of slugs belonging to at least two genera (*Limax*, and *Agriolimax*) have been connected with the life cycle of the tapeworm under discussion. (Chandler, 1923, and Kalkus, 1928). The evidence against one species, *Agriolimax agrestis*, appears quite complete. This latter is an imported species and is to be found over most of the civilized countries of the world.

Raillietina (*Skjabinea*) *cesticillus* (Molin, 1858).

While this tapeworm was never found in very great numbers, or in many flocks, during this investigation, it was located in such widely separated counties as Pontiac, Labelle, Napierville, and Kamouraska. A factor of importance is the possibility of tapeworm infection being greater at certain seasons of the year.

The essential intermediate animal host of this tapeworm was shown by Ackert (1918) to be the house fly, *Musca domestica*. Cram (1928), working on parasitic diseases of quail (*Colinus virginianus*) in South Georgia (this worm also infests quail), was able to successfully infect first the ground beetle, *Anisotarsus agilis*, and later the small dung beetle, *Chocridium histeroides*. Cram and Jones (1929), later added a further coleopteran host by naming *Anisotarsus terminatus*. Evidence was presented that indicated the possibility that *Selenophorus pedicularius* is also an intermediate host.

Hymenolepis carioca (Magal., 1898), Ransom, 1902.

To date this tapeworm has been found most abundantly in the regions of Quebec north of the Ottawa River. It appears to be well distributed in Pontiac, Labelle, and Argenteuil. It was also located in Kamouraska county.

Infestations of this worm, where they occur, are usually quite heavy. These slender and rather delicate looking parasites may seriously affect the health of the bird. On account of their size, the great numbers in which they usually occur, and because they break off from the head end very readily and are always to be found in the faecal washings, they are worms which are usually easy to locate. I consider them important parasites.

Guberlet (1920), demonstrated experimentally that this species of tapeworm may be transmitted by the stable fly, *Stomoxys calcitrans*. He reports the worm as being most abundant during the late summer and fall, at the seasons of the year when the stable fly is very prevalent. The larval worms were not demonstrated in the flies. By experimental feeding Miss Jones (1929) found that the dung beetle, *Aphodius granarius*, serves as an intermediate host. Cram and Jones (1929) reported the development of cysticercoids of this tapeworm in the dung beetle *Chocridium histeroides*, and the recovery of mature worms from quail (1 case) and chicken (1 case), which were fed unidentified cystericercoids from the beetle. These authors further indicate that the ground bettle, *Anisotarsus agilis*, may also serve as an intermediate host.

Choanotaenia infundibulum (Goeze, 1782), Railliet, 1896.

This conspicuous tapeworm has been located in Hull, Labelle, Argenteuil, Jacques Cartier, Huntingdon, and St. Hyacinthe counties. The injury found was in proportion to the number of worms in the bird. The majority of

cases of infection found were not severe. These worms have been reported as often causing the death of the vertebrate host.

According to Grassi and Rovelli (1892) and Guberlet (1916), the house fly, *Musca domestica*, is the intermediate host of this tapeworm. The latter author has worked out the complete life cycle. He isolated the cycticercoids from the flies and produced infection in chickens by feeding them with these infested muscids. Joyeux (1920), is credited with developing the cysticercoids in a small dung beetle.

Discussion

Poultry flocks in the province of Quebec that are entirely free from parasites are not common. It is quite probable that a similar examination of conditions would show the same picture in other provinces. In many cases the number of parasites in a flock have been reduced to a point where no appreciable damage may be noticed, but they are seldom entirely wiped out. This means that even in well kept plants the nucleus of a potential injurious infestation may be present. Under a change of ownership, or a slackening of viligance, a very different picture may be brought into view in a comparatively short time. In addition, it must be remembered, there are several species of parasites that frequently cause very grave losses in even the best kept plants.

The commonest internal poultry parasite in Quebec is the caecal worm, *Heterakis gallinae*. It is very prevalent everywhere. Most poultrymen may be fairly safe in assuming they have some caecal worms present in their flocks, unless they have direct evidence to the contrary.

Coccidiosis, caused by *Eimeria avium*, is one trouble that is recognized by poultrymen as a grave problem. There is that much that is favorable. Unlike it, however, a parasite like *Davainea proglottina* causes very considerable damage but still remains comparatively unknown. A second species of minute tapeworm, *Amoebotaenia sphenoides*, is present in the province and hitherto unknown in Canada. Three of the larger species of tapeworms are present and apparently widely distributed.

The large intestinal roundworm, *Ascaridia lineata*, is the most easily seen internal parasite. Unlike it, the capillary worm, *Capillaria meleagris*, is usually successfully located only by those who know its appearance and can recognize it. Yet it is probably quite important and is widely distributed.

It appears very probable that toxic substances are produced by certain of these parasitic worms which may have an injurious effect on the bird harboring them. While the toxins from worms of poultry have not been given great attention, the case against a wide range of other parasitic worms is such that we are justified in supposing that the internal worms of poultry are also probably responsible for the production of substances which have an injurious effect on the host. Schwartz (1925), says: "The view that hemolysins and other hemotoxic secretions of parasitic worms are of etiological importance in parasitic diseases appears to be well founded."

While birds heavily parasitized may show evidence of "leg weakness" a direct correlation is hardly evident. The seat of this trouble is probably the central nervous system where May, Tittsler, and Goodner (1925), have

located comparatively large lesions. Pappenheimer (1925), states it is a disease of the nervous system and that the principal lesions are to be found in the brain and spinal cord.

The condition known appropriately as "white-eye"of poultry has also been associated with worm infestation. Examination of such birds failed to establish any justification for this.

The writer has not been able to secure any evidence that infestation of chicks with parasites may occur before the hatching of the egg. Infection may occur from the time the chick starts to feed.

A dirty, ill-kept poultry plant is usually badly infested with parasites. Once introduced, the parasites find conditions favorable for their development and the numbers may increase enormously in a comparatively short time.

Parasites are not, however, confined to places where there is much dirt. Frequently a considerable number of different species of parasites have been found on plants where one might hardly expect to find any. These plants may be clean and well-kept; progressive men are in charge of them,—but the number of parasitic species is high. The answer is that parasites are probably being continually introduced into such a place. Experimental work is being carried, or at least an attempt is being made to improve the flock by the introduction of new stock. Birds brought in from elsewhere will probably bring parasites with them, until, in time, such a plant may have pretty nearly a full quota. Care and cleanliness tend to keep down many of the parasites, but the possibilities of severe trouble are continually present. Poultrymen sometimes blame egg contests, etc., for the introduction of parasites into their flocks. Probably in a few cases they may be right, but their own birds have no doubt made some contribution to the parasitic fauna of the pens where the show or contest was held.

It seems, then, that two important factors should be given consideration. Dirty conditions favor the development of parasites, while the introduction of new stock, etc., will increase the danger of parasitic invasion by bringing parasites in. In time the up-to-date poultryman may find it necessary to introduce some system of quarantine when bringing new stock to his plant. Such a system as isolating the birds on wire and behind screening, examination of their droppings, the use of anthelmintics, etc., before allowing these birds into the general flock, are suggestions.

The education of growers of poultry stock on the question of parasitic diseases is important. Improvement can hardly result if this is not done. The parasitic conditions of the flocks in the province are worse than they would be if the owners of the plants were better furnished with the knowledge of the subject which is available. Most fruit growers, if successful, have kept in intimate touch with information relative to the insects which affect their crops. Poultry raisers have not yet acquired a comparative degree of knowledge of their flock parasites.

The recommendations that could be made are very numerous. These relate chiefly to control. The points stressed here are a few that the writer thinks should be given general consideration.

Further research work with poultry parasites is badly needed. Compared to the study of pests of plants, the parasitic troubles of animals have been given very little attention in Canada. They are, at least, just as important. Our present knowledge of the subject is by no means satisfactory. In the United States more particular attention is being given to this subject, especially in the past few years. In Canada it is only a matter of time before we must awaken to the situation.

Acknowledgements

The writer is indebted to many people. It speaks well for vision of the poultry raisers of the province when it can be said that coöperation and interest were very considerable. No slaughtered birds were paid for during the course of this investigation. The assistance received from the Provincial Poultry Instructors was very real and almost indispensable. To their energy and enthusiasm I wish to pay sincere tribute. Mr. N. Savoie of the Agriculturists Branch, readily placed the assistance of his department at my disposal. This help was frequently of value. To other gentlemen the writer owes acknowledgement, particularly Mr. Hebert of Montmagny and Professor W. A. Maw of the College Poultry Department who did all in their power to bring this survey to the attention of the poultry raisers of the province.

The officers of the Zoological Division, Bureau of Animal Industry, Washington, D.C., have always shown themselves eager to furnish all possible assistance from time to time. All parasites found have been submitted to this Bureau for identification or confirmation.

References

1. Ackert, J. E. ('18), J. Parasit. Urbana, Ill., Vol. 5, pp. 41-43, 4 figs.
2. ——————('26), J. Parasit., Vol. 12, No. 3, p. 163.
3. Baker, Alex. D., R. L. Conklin, W. A .Maw, and C. D. Fogerty, ('29), Poultry Sci., Vol. 8, pp. 59-76, 9 figs.
4. Cram, E. B. ('28), U.S.D.A., Tech. Bul. 49, pp. 9, figs. 8.
5. —————— and M. F. Jones, ('29), North Amer. Vet., Vol. 10, (2), pp. 49-51.
6. Chandler, A. S. ('23), Trans. Amer. Micro. Soc., Vol. 5, 42 (3), pp. 144-147, 2 figs.
7. Grassi, G. B., and G. Rovelli, (1889), Centralbl. f. Bakteriol. u. Parasitenk. Jena, Vol. 5, pp. 370-377, 4 figs.
8. Graybill, H. W., ('21), Jour. Exp. Med., Vol. 34, No. 3, pp. 259-270, 1 pl.
9. Guberlet, J. E. ('16), Jour. Amer. Vet. Med. Assoc., Vol. 5, 49, n.s. Vol. 2 (2).
10. ——————('19), J. Parasit., Vol. 6, pp. 35-38, 4 pls., 6 figs.
11. Herrick, C. A. ('26), Amer. Jour. Hyg., Vol. 6, No. 1, pp. 153-172, 1 fig.
12. Jones, M. F. ('29), Jour. Agr. Research, U.S., Vol. 38, No. 11, pp. 629-632, 1 fig.
13. Joyeux, C. ('20), Bull. biol. de France et de Belg., Par suppl. 2, pp. 1-219, 7 pls., 6 figs.
14. May, H. G., R. P. Tittsler, and K. Goodner, ('25), Rhode Island Sta. Bul. 202.
15. Monnig, H. O. ('26), Rep. Direct. Vet. Educ. and Research, Dept. Agr. Union South Africa, Pretoria, pt. 1, pp. 199-206, 6 figs.
16. Pappenheimer, A. M., and V. Cone ('25), Connect. Storrs Bul. 136.
17. —————— L. C. Dunn, and V. Cone ('26), Connect. Storrs Sta. Bul. 143, and ('29), Jour. Expt. Med., Vol. 49, No. 1.
18. Schwartz, B. ('25), Jour. Agr. Research, Vol. 30, pp. 763-772, 18 figs.
19. Stafseth, H. J. ('29), Jour. Amer. Vet. Med. Assoc., Vol. 74, No. 7, pp. 1069-1070.
20. Tyzzer, G. E. ('27), Proc. World's Poultry Congress, 1927, pp. 286-290, 9 figs.
21. —————— ('28), J. Parasit., Urbana, Vol. 15, pp. 148.

NEW FERTILIZER MIXTURE CALCULATOR

E. L. Raynauld*
Experimental Station, Ste. Anne de la Pocatière, P.Q.

A device has been worked out lately by Prof. J. R. Proulx, College of Agriculture, Ste-Anne de la Pocatière, to facilitate the preparation of home-mixed fertilizers by farmers. The present model of the invention is about the size of a postal card and has the advantage of being operated by persons relatively unskilled in the art of mathematics and formulae.

Although the primary object of this contrivance is to facilitate the preparation of home mixtures, formulae are given on the back of the table which enable the farmer to choose amongst the various mixtures those more suitable for the growing of specific crops cultivated on sandy land, loam or clay. It should be noted that these formulae can be used either for the preparation of home-mixed fertilizers or the buying of ready prepared mixtures.

The mechanical construction of the device consists of two disks of unequal size, the smaller one being pivoted on the common center by means of a rivet. Figure I is a plan view of the calculator with larger disk removed, while figure II shows the calculator as disposed for a given calculation.

It is known that complete fertilizers are expressed in agricultural literature by formulae such as 5-8-7, 4-8-10, etc., which means 5% nitrogen, 8% phosphoric acid and 7% potash. It is why in the present calculator a fertilizer of group I (nitrogen containing materials) must be used for calculating the first figure of the formula, while a fertilizer of group II (phosphorus containing materials) must be used for calculating the second figure of the formula and a fertilizer of group III (potassium containing materials) must be used for calculating the third figure of the formula.

As for example and for purpose of illustration, assumnig that one wants to prepare a ton of 4-8-10 with ammonia sulphate, susper-phosphate, and potash sulphate, the procedure would be as follows:

Dispose the words	Ammonia sulphate	opposite figure	4:	Answer	400	lbs.
" " "	Superphosphate	"	"	8:	"	1000	"
" " "	Potash sulphate	"	"	10:	"	400	"

Mixing the above quantities of fertilizers will make a total of 1800 lbs. which is equal to a ton of 4-8-10.

The quantity of simple fertilizer to use per 1000 lbs. of mixture is also given and this will be found very handy by experimental workers who generally need small quantities of a given mixture. Knowing the necessary weight of ingredients for 1000 pounds of a given mixture, the quantity needed for 100 lbs. or even 10 lbs. of the same mixture is already found.

The publication of this device seems to be a good method to vulgarize amongst the farmers the essential principles concerning the preparation and the use of chemical fertilizers. It can also be easily carried about for quick reference by extension workers.

*Assistant-Superintendent.

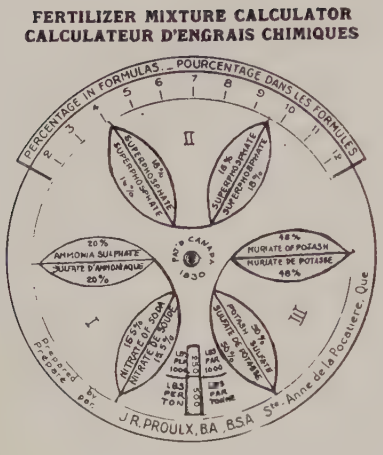

Figure I.

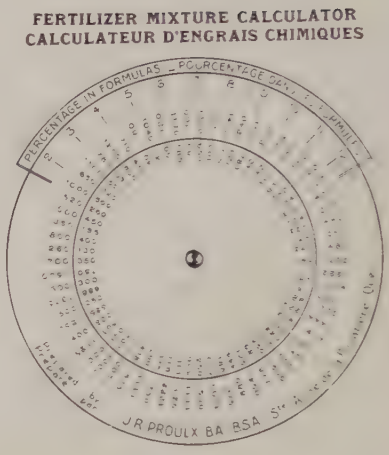

Figure II.

DIRECTIONS.—Dispose the name of the fertilizing material used opposite the figure representing the percentage in formula and the quantity of fertilizer to use per ton or 1000 lbs. of mixture will appear through the window. Use a fertilizer of each group.

INSTRUCTIONS.—Placez le nom de l'engrais simple employé vis-à-vis du chiffre indiquant le pourcentage dans la formule et la quantité d'engrais simple à employer par tonne ou 1000 lbs. du mélange apparaitra par l'ouverture. Employez un engrais de chaque groupe.

CROPS	SAND	LOAM	CLAY	Lbs. per acre	CULTURES
Potatoes	4-8-10	5-8-7	4-8-6	800	Pommes de terre
Corn	4-8-8	4-10-4	10-6-0	500	Mais (Blé d'Inde)
Mangels	4-8-10	4-8-7	3-12-6	800	Betteraves
Turnips	4-12-4	3-10-3	0-16-0	500	Choux de Siam, Navet
Tomatoes	4-8-10	4-8-7	3-8-6	800	Tomates
Tobacco	4-8-10	3-9-8	3-8-6	1000	Tabac
Garden	6-8-10	5-10-5	4-10-4	800	Jardin
Cereals (Grain)	4-10-5	2-8-7	0-16-0	400	Céréales (Grain)
Peas	2-8-8	2-6-7	0-16-0	500	Pois
Flax	5-6-8	4-5-8	4-6-6	400	Lin
Hay	5-10-5	6-8-0	15-0-0	150	Foin
Pasture	3-8-6	2-6-7	2-8-4	300	Paturage

NOUVEAU CALCULATEUR D'ENGRAIS CHIMIQUES

E. L. RAYNAULD*
Station Expérimentale, Ste-Anne de la Pocatière, P.Q.

Monsieur J. R. Proulx, autrefois assistant-régisseur, à la Ferme Expérimentale de Ste-Anne de la Pocatière, et aujourd'hui professeur à l'Ecole d'Agriculture du même endoit, vient de préparer un tableau destiné à faciliter beaucoup la préparation, sur la ferme, des engrais chimiques complets. Ce tableau a environ la grandeur d'une carte postale et est assez facile à comprendre pour que toute personne puisse l'utiliser avantageusement.

Bien que le but principale de ce calculateur soit de faciliter la préparation des mélanges d'engrais chimiques sur la ferme, il contient en plus au verso plusieurs formules recommandées pour certaines récoltes qu'elles soient

*Assistant-Régisseur.

cultivées sur le sable, la terre franche ou la terre forte, permettant ainsi au cultivateur de mieux choisir ce qui lui convient. Il est à remarquer que ces formules en plus de servir à la préparation des mélanges sur la ferme peuvent aussi être consultées pour l'achat des mélanges commerciaux.

Ce tableau calculateur est fait de deux disques de grandeur différente réunis au centre par un rivet. La première gravure représente le petit disque où sont inscrits, par groupe, les divers engrais qui serviront à préparer les melanges tandis que la deuxième gravure représente le grand disque contenant les chiffres qui donneront les quantités d'engrais à employer dans les mélanges.

Les engrais complets du commerce étant toujours étiquettés suivant ceratine formules telles que 5-8-7, 4-8-10, etc. ce qui veut dire que cet engrais contient 5% d'azote, 8% d'acide phosphorique et 7% de potasse, il s'en suit que pour préparer la quantité d'engrais représenté par le premier chiffre de la formule, il faudra se servir d'un des engrais mentionnés dans le premier groupe sur le calculateur. Pour avoir la quantité représentée par le deuxième chiffre de la formule, on se servira des engrais mentionnés au deuxième groupe ou phosphatés et ainsi pour celledu troisième chiffre qui représente les engrais potassiques.

Un exemple de la préparation d'un de ces engrais illustrera davantage la procéducè à suivre: Supposons qu'on veuille préparer une tonne d'engrais 4-8-10 avec du sulfate d'ammoniaque, du superphosphate et du sulfate de potasse. Plaçons la ligne indiquant le sulfate d'ammoniaque vis-à-vis le chiffre quatre du tableau qui représente le pourcentage dans la formule et nous avons à l'ouverture faite dans le disque la quantité de sulfate d'ammoniaque à employer, soit 400 livres. La ligne indiquant le superphosphate placés vis-à-vis le chiffre 8 donne à l'ouverture du disque, la quantité de superphosphate à employer, soit 1000 livres. Le sulfate d'ammoniaque placé vis-à-vis le chiffre 10, nous obtenons la quantité requise de sulfate de potasse, soit 400 livres. En mélangeant les quantités ainsi obtenues, nous avons un total de 1800 livres équivalant à une tonne de 4-8-10.

La quantité d'engrais simple à employer pour 1000 livres de mélange est aussi donnée et cela devrait être pratique pour les expérimentalistes, qui le plus souvent, demandent de petites quantités de melange. Sachant le poids des ingrédients nécessaires pour 1000 livres, la quantité par 100 livres ou par 10 livres est de ce fait très vite trouvée.

L'emploi de ce calculateur devrait contribuer à vulgariser chez les cultivateurs les données essentielles concernant la préparation et l'emploi des engrais chimiques.

LES PARASITES INTERNES DES VOLAILLES DANS QUEBEC*

ALEX. D. BAKER
Macdonald College (McGill University), P.Q.

L'importance des parasites internes des volailles est assez bien admise, ou au moins, devrait l'être d'une façon générale. Le sujet est de grande importance pour l'aviculteur en particulier.

Au cours de la dernière année, l'auteur s'est intéressé à l'etude des parasites internes des oiseaux de basse-cour à l'égal des différents autres problèmes de recherche dans lesquels il fut engagé antérieurement. On a déjà signalé certains progrès à ce sujet, et récemment ,avec la collaboration du National Research Council of Canada, un projet d'étude consistant en une inspection des parasites internes des volailles fut lancé par toute la Province de Québec. Bien que ces recherches ne soient pas complètes, nous pouvons cependant mentionner que ce travail est encore à ses débuts et devrait servir de base à de nouvelles investigations. Quelques sections de la province furent assez bien étudiées; y compris les frontières ouest, sud et est. Plusieurs comtés du centre n'ont pas encore été soumis à l'étude; mais la distribution assez partagée d'une espèce quelconque de ces parasites peut servir à nous indiquer la présence possible de ces ennemis dans un territoire non étudié.

On a trouvé jusqu'à date neuf différentes espèces de parasites internes, telles que: *Eimeria avium, Ascaridia lineata, Heterakis gallinae, Capillaria meleagris-gallopavo, Amoebotaenia sphenoides, Davainea proglottina, Raillietina (Skjabinea) cesticillus, Hymenolepis caroica,* and *Choanotaenia infundibulum.*

Les troupeaux de volailles qui sont exempts de parasites internes sont relativement rares dans la Province de Québec. Il est assez probable qu'une inspection soignée nous révèle des conditions semblables dans d'autres provinces. Il fut observé qu'en certains cas, le nombre des parasites dans un troupeau fut réduit au point ou on ne pouvait pratiquement pas remarquer de dégâts; mais il arrive très rarement que l'infestation soit nulle. Ceci veut simplement dire que même dans une installation avicole des mieux tenues, le germe d'une infestation possible peut être présent quand même. A cause d'une changement de propriétaire ou du manque de vigilance, une nouvelle infestation peut facilement avoir lieu dans une courte période de temps. Il faut aussi se rappeler qu'il y a plusieurs espèces de parasites susceptibles de causer de grave dégâts même dans les basses-cours les mieux tenues.

Le parasite interne des volailles le plus commun dans cette province est le ver caecal *Heterakis gallinae.* Il domine les autres espèces généralement partout. La plupart des aviculteurs peuvent facilement prétendre que le ver caecal est présent chez leurs volailles à moins qu'ils aient des évidences directes du contraire.

La Coccidiose, causée par *Eimeria avium,* est une maladie connue des aviculteurs comme un problème sérieux. Un parasite comme *Davainea proglottina,* au contraire, cause des dégâts considérables tout en demeurant prati-

*Traduction en français par M. J. B. Maltais, Hemmingford, Que.

quement inconnu. Une autre espèce de petit tenia, *Amoebotaenia sphenoides*, est présent dans la province de Québec et jusqu'ici inconnu au Canada. Trois espèces de tenia de plus grandes dimensions sont apparemment très répandues dans le pays.

Le grand Ascaride intestinal, *Ascaridia lineata*, est le parasite interne le plus visible. Le ver capillaire, au contraire, est ordinairement localisé par ceux qui le connaissent très bien. Ce dernier est aussi très important et généralement répandu.

Il semble fort probable que des substances toxiques soient produites par certains de ces vers parasites. Ces toxines peuvent avoir un effet désastreux sur les oiseaux actuellement parasités. Bien que l'on n'ait pas porté grande attention aux toxines sécrétées par les vers des volailles, ce qui se passe chez un grand nombre d'autres vers parasites peut nous amener à supposer que les vers internes des volailles sont probablement responsables pour la production de substances ayant un effet nuisible sur l'hôte. Schwartz (1925) dit: "L'opinion semble bien fondée que les hémolysines ou les autres sécrétions hémotoxiques des vers parasites sont d'importance écologique dans les maladies parasitaires."

Bien que les oiseaux sévèrement parasités puissent montrer des signes de "faiblesse de patte", une corrélation directe est à peine évidente. Le siège de cette maladie réside probablement dans le système nerveux central, là où Tittsler et Goodner (1925) ont localisé des lésions comparativement étendues. Pappenheimer (1925) déclare que c'est une maladie du système nerveux, et que les lésions principales sont localisées dans le cerveau et la moelle épinière.

La maladie des volailles connue sous le nom de "white-eye" fut également associée aux troubles parasitaires. Une inspection minutieuse des oiseaux malades ne put justifier ce fait.

L'auteur n'a pas été capable d'obtenir aucune évidence démontrant la possibilité d'une infestation avant l'éclosion des poussins. Dès que ceux-ci commencent à s'alimenter, les parasites deviennent alors ménaçants.

Une basse-cour malpropre et négligée est généralement infestée de parasites. Ces êtres, une fois introduits dans un troupeau de volailles, trouvent toujours des conditions favorables à leur développement et leur nombre est susceptible d'un accroissement considérable dans une période de temps relativement courte. L'infestation possible ne se limite pas seulement aux endroits malpropres; mais il arrive fréquemment qu'un nombre considérable d'espèces de parasites se trouvent dans des basses-cours proprement tenues et dirigées par des aviculteurs très soigneux. Il peut aussi se faire que des parasites soient continuellement introduits dans ces basses-cours. Par expérimentation, ou au moins par l'introduction d'un nouveau troupeau de volailles, l'aviculteur pourra améliorer quelque peu la situation; mais sera-t-il sûr que les volailles venant d'ailleurs n'apporteront pas de parasites, qui, après une certaine période de temps, causeront des dégâts sérieux. La surveillance et la propreté semblent tenir les parasites en échec bien que les possibilités d'une infestation sérieuse soient à redouter. Les aviculteurs jettent

souvent le blâme sur les concours de ponte s'il y a introduction de parasites dans leurs troupeaux. Ils peuvent sans doute avoir raison en ce cas; mais il est possible que leur propres volailles aient contribué au développement des parasites lors d'un concours de ponte antérieure.

Il semble que deux facteurs importants entrent en considération. Les conditions de malpropreté favorisent le développement des parasites tandis que l'introduction de nouvelles volailles augmente le danger d'une invasion parasitaire. Avec le temps, l'aviculteur de progrès trouvera peut être nécessaire d'avoir recours à un système de quarantaine quand il jugera à propos de renouveler son troupeau. L'isolation des oiseaux en cages métalliques, l'examen des fientes, l'usage de vermifuges, etc., sont autant de suggestions qu'il sera bon de considérer avant d'admettre un nouveau troupeau dans la basse-cour.

Les conditions parasitiques des volailles dans notre province seraient grandement diminuées si tous les propriétaires de basses-cours possédaient plus de connaissances sur ce point. Il est reconnu que la plupart des horticulteurs de progrès attachent beaucoup d'importance à l'étude des maladies et des insectes nuisibles à leurs récoltes. Les aviculteurs, au contraire, n'ont pas encore acquis un dégré suffisant de connaissances au sujet des parasites nuisibles à leurs volailles.

Les recommandations qui peuvent être données sont très nombreuses. Celles-ci auraient surtout rapport au contrôle.

Des travaux de recherches sur les parasites internes des volailles seraient grandement nécessaires. En comparaison avec les différents fléaux des plantes, les troubles parasitiques des animaux n'ont pas reçu l'attention suffisante au Canada. Ces derniers sont tout aussi importants que les autres. Aux Etats-Unis, surtout en ces dernières années, on a attaché beaucoup d'importance à cette question des maladies parasitaires des animaux. C'est avec le temps et les connaissances que nous arriverons à réaliser la situation telle qu'elle existe actuellement.

LES CHAMPS ET LA FERME

Nous recevions récemment une copie de la publication "Les Champs et la Ferme", éditée par la Compagnie Imperial Oil Ltd. Ce volume constitue jusqu'à un certain point une traduction de "Field and Farmyard" préparé l'an dernier par Duncan Marshall pour le compte de cette Compagnie. Cependant, Monsieur Robert Raynauld, B.A., M.S.A., rédacteur de "La Terre de Chez Nous", mérite de sincères félicitations pour son excellente traduction française et surtout pour son adaptation très heureuse à nos conditions de l'Est. De fait, cette oeuvre diffère grandement de la copie anglaise par l'augmentation de certains chapitres, le choix des photographies et la collection d'articles d'experts de chez nous.

On ne saurait trop insister sur l'importance de cet ouvrage. L'honorable J.-L. Perron, ministre de l'Agriculture de notre Province, après quelques considérations générales sur l'état actuel de notre agriculture apprécie en ces

termes cette brochure dans une intorduction qu'il a signée lui-même: "Je ne puis faire mieux que de recommander cette petite encyclopédie de la ferme, parce que je suis certain qu'elle rendra de grands services à ceux qui la consulteront".

"Je dois féliciter aussi la Compagnie Imperial Oil de son heureuse innovation que je voudrais voir suivie par toutes les autres grandes compagnies industrielles. C'est dans l'aide apportée par l'industrie à l'agriculture que naîtra la plus forte et la plus durable prospérité de notre pays".

M. Aldéric Lalonde, président-général de l'U.C.C., dans une seconde introduction encourage fortement les membres de l'Association en particulier et tous les cultivateurs en général, à faire demander de ce volume "dont la lecture ne pourra que leur être très profitable". Il se fait un devoir de féliciter les directeurs de cette importante firme pour leur geste splendide à l'égard des Canadiens-Français.

L'espace nous fait défaut pour mentionner les noms des auteurs des excellentes contributions qui émaillent ces pages. Nous notons cependant qu'elles nous ont été fournies par des techniciens agricoles renommés de la Province de Québec.

Ce manuel est joli de forme, et sa tenue typographique est à peu près parfaite.

Nous sommes convaincus que tous les membres de la C.S.T.A. Canadiens-Français et ceux de langue anglaise lisant le français trouveront plaisir et profit à le parcourir. Ils obtiendront une copie gratuitement en s'adressant à Imperial Oil Ltd., B.P. 1440, Montréal, P.Q.

Enfin, si après avoir pris connaissance de cet ouvrage on le croit de nature à aider le cultivateur, on pourra conseiller sa demande *gratuite* car on voudra bien se rappeler qu'il existe une copie pour chaque foyer agricole de la Province.

CONCERNING THE C. S. T. A.

Notes and News

J. H. Craigie (Harvard '24), Officer-in-Charge of the Dominion Rust Research Laboratory, Winnipeg, Man., recently attended the International Botanical Congress held at Cambridge, England. An arrangement has been effected for an exchange between Mr. Craigie and Dr. W. A. R. Dillon Weston, Advisory Mycologist at the School of Agriculutre, Cambridge University, and the latter arrived in Canada early in August to spend a year at the Dominion Rust Research Laboratory in Winnipeg. In the meantime, Mr. Craigie is taking advantage of his twelve months' leave of absence studying at the School of Botany, Cambridge, England. The exchange was arranged through the Dominion Department of Agriculture, the Ministry of Agriculture and Fisheries and the Empire Marketing Board.

H. G. L. Strange of Fenn, Alberta, has been chosen by the Searle Grain Company Limited as the Director of its Agricultural Research Department and is at present engaged in special field crop improvement research. His address is c/o Searle Grain Co., Ltd., 378 Grain Exchange Building, Winnipeg, Man.

E. E. Brockelbank (Saskatchewan '22) who has been taking graduate work at the University of Minnesota has returned to Canada. His address is Suite 1, Clay Block, Saskatoon, Sask.

R. Schafheitlin (McGill '16) has resigned his position with the Canard Fruit Company to undertake some work for the Dominion Department of Agriculture. His mailing address is P. O. Box 523, Canning, N.S.

J. E. Machacek (McGill '28), formerly Lecturer in Plant Pathology at Macdonald College, P.Q., has been appointed Assistant Plant Pathologist at the Dominion Rust Research Laboratory, Winnipeg, Man.

Rozemond Caron (Laval '25) has received the appointment of Federal Illustration Stations' Supervisor with headquarters at the Dominion Experimental Station, Ste. Anne de la Pocatière, P.Q.

J. A. Anderson (Alberta '26) for the past four years Assistant in Plant Biochemistry at the University of Alberta, has been appointed Junior Research Biologist with the National Research Council. He has recently received the degree of Ph.D.

E. N. Blondin (McGill '14) District Sales and Service Representative for the Ralston-Purina Company, has changed his address to 27 Dobie Street, Mount Royal, P.Q.

V. S. Asmundson (Saskatchewan '18) and D. G. Laird (Toronto '15) have both completed work towards the degrees of Ph.D. at the University of Wisconsin. Professor Laird, formerly Assistant Professor of Agronomy, has been appointed Associate Professor of Agronomy at the University of British Columbia, Vancouver, B.C.

J. DeBroin (Paris '24), formerly Feed Specialist with the Maple Leaf Milling Co., Ltd., is now Feed Specialist with the Western Canada Flour Mills, Ltd. His address is 4080 St. Hubert St., Montreal, P.Q.

C. Shirriff (Manitoba '29) has changed his address to 2130 Montague Street, Regina, Sask.

F. G. McLeod (McGill '30), has been appointed District Representative with the New Brunswick Department of Agriculture. His mailing address is P.O. Box 279, Moncton, N.B.

H. R. Murray (Toronto '23) who has spent four months at work with the Dominion Seed Branch after completing residence and course work towards a Ph.D. at Cornell University, has received the appointment of Assistant Professor of Horticulture at Macdonald College, P.Q. He took over his new duties on October 1, 1930.

N. Parent (Laval '26), Accountant for Demonstration Farms, Dept. of Agriculture, Quebec, was married on October 11th to Miss Yvonne Gregoire of St. Isidore, Dorchester, P.Q.

J. P. Fleury (McGill '25), who is with the Dominion Live Stock Branch, Montreal, has changed his address to 2601 Boulevard Pie IX, Montreal, P.Q.

* * *

The following members of the Society have reported that they have registered for graduate work at the institutions named:

H. B. Sommerfield (Saskatchewan '21), University of Minnsota, St. Paul, Minn., U.S.A., in Animal Husbandry.

W. L. Gordon (McGill '22), University of Wisconsin, Madison, Wis., U.S.A., in Plant Pathology. His address until February 1, 1931, will be 1701 University Avenue, Madison, Wis., U.S.A.

L. T. Wilson (Saskatchewan '24), University of Wisconsin, Madison, Wis., U.S.A., in animal nutrition, residing at 214 South Randall Avenue, Madison Wis., U.S.A.

G. A. Ledingham (Saskatchewan '27), University of Toronto, Toronto, Ont., in botany.

T. O. Graham (Toronto '28), University of Minnesota, St. Paul, Minn., U.S.A., in horticulture.

W. A. F. Hagborg (Manitoba '29), University of Toronto, Toronto, Ont., in botany.

J. M. Ramsbottom (Toronto '29), Iowa State College, Ames, Iowa, in animal husbandry.

D. F. Patterson (McGill '27), University of Toronto, Toronto, Ont., in chemistry.

E. R. Bewell (Manitoba '14), University of British Columbia, Vancouver, B.C., in agricultural economics.

R. J. Milligan (Alberta '30), Iowa State College, residing at 321 Lynn Avenue, Ames, Iowa, U.S.A.

A. T. Elders (Manitoba '24), University of Minnesota, St. Paul, Minn., U.S.A. in Agronomy.

The successful candidates for the five T. Eaton Company Scholarships awarded by the Society in June 1930 have taken up their respective scholarships and are pursuing their studies as follows:

Sinclair, R. D. (Alberta, 1918, B.S.A., Iowa, 1926, M.S.), The Rowett Research Institute, Bucksburn, Aberdeen, Scotland, in animal genetics and animal nutrition.

Longley, R. P. (McGill, 1930, B.S.A.), University of Toronto, Toronto, Ont., in agricultural economics, residing at 21 Chicora Ave., Toronto.

Moss, H. C. (Saskatchewan, 1924, B.S.A.), University of Alberta, Soils Department, Edmonton, Alta.

Putnam, D. F. (Toronto, 1927, B.S.A.), University of Toronto, Toronto, Ont., in plant pathology.

Russell, R. C. (Saskatchewan, 1924, B.S.A., 1926, M.S.A.), University of Toronto, Toronto, Ont., in plant pathology and mycology.

Applications for Membership

The following applications for regular membership have been received since October 1, 1930:

Bell, L. (Saskatchewan, 1930, B.S.A.), Saskatoon, Sask.

Colbert, A. H. O. (Toronto, 1927, B.S.A.), Saskatoon, Sask.

Haslam, G. L. (McGill, 1930, B.S.A.), Ottawa, Ont.

Johnson, R. E. (McGill, 1930, B.S.A.), Ottawa, Ont.

Laforce, J. E. (Nicolet, 1897, B.S.A.), Montreal, P. Q.

MacKey, E. M. (Toronto, 1927, B.S.A.), Ottawa, Ont.

MacRea, N. A. (McGill, 1930, M.Sc.), Ottawa, Ont.

MacVicar, R. M. (McGill, 1930, B.S.A.), Ottawa, Ont.

Munro, S. S. (McGill, 1930, B.S.A.), Ottawa, Ont.

Parris, G. K. (McGill, 1930, B.S.A.), Ithaca, N. Y.

Rutherford, J. B. (Saskatchewan, 1930, B.S.A.), Saskatoon, Sask.

Meeting of Eastern Ontario Local Branch

At a special meeting of the Eastern Ontario local of the C.S.T.A. held in the Dominion Headquarters, Ottawa, on Thursday evening, October 2nd, Mr. C. M. Meek, (Toronto '22), of the Ottawa Dairy Staff was elected president of the branch.

Previous to the business meeting, the local opened its winter bowling league with the first session at Karry's Alleys. A large number of the members have signified their intention of bowling this year.

Mr. M. B. Davis, Chief Assistant, Division of Horticulture, Central Experimental Farm, gave a lecture on his impressions of a year of research work in England.

The meeting was well attended and plans were made for a good winter's programme.

SELECTED LIST OF ACCESSIONS TO THE MAIN LIBRARY OF THE DOMINION DEPARTMENT OF AGRICULTURE, OTTAWA.

Members of the C.S.T.A. may borrow books and periodicals post free by addressing a request to Miss A. L. Shaw, Librarian, Department of Agriculture Library, Ottawa, Ont.

Antsiferov, A. N. and others. Russian agriculture during the war. New Haven, Yale university press, 1930. 394 p. (Economic and social history of the world war, published by the Carnegie endowment for international peace).

American medical association. Health education; a program for public schools and teacher training institutions. New York, 1930. 251 p. Bibliographies at ends of chapters.

Bercaw, L. O. comp. Rural standards of living; a selected bibliography. Washington, D.C. 1930. 124 p. mimeo. (U.S.D.A. Bureau of agricultural economics. Bibliography 32).

Betters, P. V. The bureau of home economics; its history, activities, and organization. Washington, D.C. Brookings institution, 1930. 95 p. (Institute for government research. Monograph 62).

Bower F. O. Size and form in plants with special reference to the primary conducting tracts. London, Macmillan co. 1930. 232 p. il. $3.60.

Bowker, Horace. A survey of the farm problem with particular reference to wheat production costs. New York, American agricultural chemical co. 1930. 16 p.

Buchanan, R. E. and Fulmer, E. L. Physiology and biochemistry of bacteria. Vol. II. Effects of environment upon microörganisms. Vol. III. Effects of microörganisms upon environment. Fermentative and other changes produced. Baltimore, Williams & Wilkins co. 1930. 2 vols. (Vol. I. is also in library).

Canada. Dept. of labour. Ninth report on organization in industry, commerce & the professions in Canada, 1930. Ottawa, 1930. 140 p.

Carrothers, W. A. Emigration from the British Isles with special reference to the development of the Overseas Dominions. London, P. S. King & son, ltd. 1929. 328 p. 15s.

Castle, W. E. The genetics of domestic rabbits; a manual for students of mammalian genetics and an aid to rabbit breeders and fur farmers. Cambridge, Harvard university press, 1930. 31 p. plates. Bibl. p. 31.

Chenevard, W. Traité d'ovoculture: l'oeuf; sa production familiale, fermière, et industrielle; son commerce en France et dans le monde. Paris, J. B. Baillière & fils, 1930. 416 p. il.

Congrès du carbone végétal ... et exposition forestière, Lyon, 1929. Comptes rendus. Paris, Service agricole de la cie. P.L.M. 1930. 406 p. illus.

Congrès international des fabricants de chocolat et de cacao, Anvers, 1930. Volume préparatoire. Bruxelles, 1930. 384 p.

Congrès international d'oléiculture. 9th, Turin, 1928. Tunis, Imprimerie centrale. 1929. 2 vols.

Correvon, Henry. Rock garden and Alpine plants. New York. Macmillan co. 1930. 544 . il. $5.85.

Dalgety & co. ltd. Dalgety's annual wool review for Australasia 1929-30. Vol. 32. Sydney, N.S.W. 1930. 179 p.

Dillon, E. J. Russia to-day and yesterday; an impartial view of Soviet Russia. Garden City, N.Y. Doubleday, Doran & co. 1930. 325 p. illus. $3.50.

Elsworth, R. H. Coöperative marketing and purchasing, 1920-30. Washington, D.C. 1930. 55 p. (U.S. Dept. of agriculture. Circ. 121).

Empire marketing board. Agricultural maps of the British Isles. London, 1930. 3 maps 40 x 60 inches.

Empire marketing board. The dissemination of research results among agricultural producers ... London, 1930. 136 p. (E.M.B. 33).

Fédération belge des sociétés des sciences. Les institutions d'enseignement supérieur et de recherches en Belgique, 1930. Bruxelles, 1930. 150 p. il.

Fitzpatrick, H. M. The lower fungi: Phycomycetes. New York, McGraw-Hill book co. inc. 1930. 331 p. il. $4.00.

Gabbard, L. P. and others. Planning the ranch for greater profit, College Station, Texas, 1930. 45 p. (Texas A.E.S. Bulletin 413).

Gt. Brit. Dept. of scientific and industrial research. Index to the literature of food investigation, Vol. 2, no. 1, Mar. 1930. London, 1930. 108 p.

Gt. Brit. Laws, statutes, etc. Agricultural marketing; a bill to enable schemes to be made for regulating the marketing of certain agricultural products ... London, 1930. 19p. (Bill 257).

Gt. Brit. Medical research council. The antiscurvy vitamin in apples, by M. F. Bracewell and others. London, 1930. 45 p. diag. (Special report series no. 146).

Gt. Brit. Secretary of state for foreign affairs. International agreement for the establishment of an international bureau of intelligence on locusts. London, 1930. 12 p. (Treaty series no. 16, 1930).

Gt. Brit. Secretary of state for foreign affairs. International convention for the abolition of import and export prohibitions and restrictions, Geneva, Nov. 8, 1927 and supplementary protocol, 1929. London, 1930. 79 p. (Treaty series no. 10, 1930).

Gronemann, C. F. Fifty common plant galls of the Chicago area. Chicago, 1930. 30 p. il. Bibl. p. 30. (Field museum of natural history. Botany leaflet no. 16).

Hultz, F. S. Range beef production in the seventeen western states. New York, John Wiley & sons, inc. 1930. 208 p. il. $2.50.

Imperial bureau of soil science. Determination of exchangeable bases and lime requirements. Harpenden, Rothamsted experimental station, 1930. 37 p. References pp. 32-37 (Technical communication 12).

Imperial economic committee. Progress report, 1930. London, 1930. 16 p.

Institut international d'agriculture. Nombres-indices des prix des produits agricoles et autres nombres-indices des prix intéressant l'agriculture. Rome, 1930. 125 p.

Johnson, E. M. Virus diseases of tobacco in Kentucky. Lexington Ky. 1930. pp. 289-415. (Kentucky A. E. S. Bulletin 306).

Madill, A. J. History of agricultural education in Ontario. Toronto, University of Toronto press, 1930. 264 p.

Matsuura, Hajime. A bibliographical monograph on plant genetics (genic analysis) 1900-1925. Tokyo, Imperial university, 1929. 499 p. $4.00.

Melin, Elias. Investigations of the significance of tree mycorrhiza; an ecological-physiological study. Translated by P. W. Stickel. Ann Arbor, Mich. Edwards bros. 1930. 173 p. mimeo. Bibl. pp. 167-173.

Mitrany, David. The land and the peasant in Rumania ... New Haven, Conn. Yale university press, 1930. 627 p. Bibl. pp. 594-611. (Carnegie endowment for international peace. Economic and social history of the world war. Rumanian series).

Motz, W. H. Principles of refrigeration ... 2d ed. Chicago, Nickerson & Collins co. 1929. 707 p. il. $5.00.

New South Wales. Dept. of agriculture. The cattle tick question; a catechism on tick control and eradication. Sydney, 1930. 24 p.

Ontario. Royal commission on public welfare. Report. Toronto, 1930. 111 p.

Paustian, P. W. Canal irrigation in the Punjab; an economic inquiry relating to certain aspects of the development of canal irrigation by the British in the Punjab. New York, Columbia university press, 1930. 181 p. Selected references pp. 173-5.

Post, Emily. The personality of a house; the bok of home design and decoration. New York, Funk & Wagnalls co, 1930. 529 p. illus. $3.60.

Puri, A. N. A new method of estimating total carbonates in soils. Calcutta, 1930. 7 p. (Imperial institute of agricultural research, Pusa. Bulletin 206).

Pyne, Gould, Guinness, ltd. Annual review of wool, stock, meat and produce markets, 1929-30. Christchurch, N.Z. 1930. 40 p. il.

Reinecke, O.S.H. Field and laboratory studies of the pollination requirements of varieties of deciduous fruit trees grown in South Africa. Pretoria, 1930, 92 p. il. (South Africa. Dept. of Agriculture. Science bulletin 90).

Rowan, William. Experiments in bird migration. I. Manipulation of the reproductive cycle: seasonal histological changes in the gonads. Boston, 1929. pp. 151-208. (reprint from Proceedings of the Boston society of natural history. Vol. 39, no. 5).

Scottish society for research in plant-breeding. Report 1929-30. Corstorphine, 1930. 32 p.

Shutt, F. T. High protein pasture (reprint from Chemistry and industry. Vol. 49, no. 33, Aug. 15, 1930, pp. 679-81).

South Africa. Office of census and statistics. Official year book. Vol. II, 1928-29. Pretoria, 1930. 1143 p.

Thom, Charles. The Penicillia. Baltimore Williams & Wilkins co. 1930. 643 p. Bibl. pp. 601-24. $10.00.

U. S. Library of congress. Subject headings used in the dictionary catalogues of the Library of congress, ed. by M. W. McNair. 3d ed. Washington, D.C. 1928. 1535 p. $6.00.

U. S. National committee on wood utilization. You can make it for camp and cottage; practical uses for secondhand wooden containers and odd pieces of lumber. Washington, D.C. 1930. 49 p.

Western Canada live stock union. Annual report of seventeenth annual convention, 1930. Regina, Sask. 1930. 158 p.

Wisconsin academy of sciences, arts & letters. Transactions. Vol. 25. Madison Wis. 1930. 413 p. il.